THE
Ship-Builder's Aſſiſtant;
OR,
MARINE ARCHITECTURE.

CONTAINING

I. DECIMALS, the Extraction of the Square and Cube ROOTS, alſo GEOMETRY and MENSURATION: With RULES for finding the Content of PLANK and TIMBER, alſo the TUNNAGE of SHIPS; illuſtrated by proper Examples.

II. Obſervations on the Nature and Value of TIMBER, and how to procure it in the neceſſary FORMS for SHIP-BUILDING.

III. The Method of drawing PLANS of SHIPS, and moulding their TIMBERS; with the practical RULES to be obſerved in building the HULLS of different SHIPS: To which is added, the SCANTLING or DIMENSION of SHIPS TIMBERS.

IV. Directions for making MASTS and YARDS in juſt Proportion to the SHIP, and to each other. Alſo TABLES of the WEIGHTS and SIZES of ANCHORS and CABLES, according to the New Eſtabliſhment.

V. The BOATSWAINS ART: Shewing the Method of finding the Length and Thickneſs of every ROPE. Alſo CABLE and CORDAGE TABLES, ſhewing by Inſpection the WEIGHT of any ROPE. With Directions for Cutting out SAILS.

The Whole reviſed, corrected, and illuſtrated with many COPPER-PLATES.

By WILLIAM SUTHERLAND,
SHIPWRIGHT and MARINER.

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PREFACE.

THE Advantages ariſing from Shipping to theſe Kingdoms, are ſo great and conſpicuous, that it would be ſuperfluous to advance Arguments in Favour of the Art of SHIP-BUILDING, or MARINE ARCHITECTURE; and therefore whatever has the leaſt Tendency to its Advancement, certainly merits Encouragement. It ſhould alſo be remembered, that every Improvement made in an Art of ſuch Importance to Society, adds a farther Security to the Power, Strength, and Intereſt of theſe Kingdoms.

Animated with this pleaſing Proſpect, and alſo with a Deſire of inſtructing Young SHIPWRIGHTS, and thoſe Gentlemen who are deſirous of being acquainted with theſe ſurprizing Fabrics, the AUTHOR has compiled the following Treatiſe; in which he has endeavoured to lay every Thing down in the moſt plain and perſpicuous Manner, and flatters himſelf that he has in ſome Degree ſucceeded.

The ſeveral Particulars treated of in this WORK, immediately follow the Preface, therefore it is ſuperfluous to enumerate them here. But it may not be improper to obſerve, that, in order to render this WORK more generally Uſeful, the AUTHOR has added the Manner of proportioning MASTS, YARDS, RIGGING, *&c.* and calculated ſeveral TABLES for the Reader's Eaſe, and to make this Work as uſeful to BOATSWAINS and MARINERS, as to SHIPWRIGHTS.

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MARINE ARCHITECTURE,
OR, THE
THEORY of SHIP-BUILDING.

CHAP. I.
OF
DECIMAL ARITHMETIC,
AND THE
EXTRACTION of ROOTS.

DEFINITIONS.

A Fraction is called *Vulgar* or *Decimal*, according as it is divided, as $\frac{3}{5}$ is called a *Vulgar Fraction*, the uppermoſt Number is called the *Numerator*, and the undermoſt the *Denominator*.

A *Decimal* Fraction ſuppoſes *one* of any thing whatever to be divided into 10 Parts, 100 Parts, 1000 Parts, &c. and hath always a Dot ſet before it, as .5 is called 5 Tenths, and in Vulgar Fractions $\frac{5}{10}$; but as Decimals are moſt to the Purpoſe here, I ſhall ſay no more of Vulgar Fractions than what is abſolutely neceſſary.

As Places in whole Numbers increaſe by Tens, ſo do Places in Decimals decreaſe by Tens; for as the firſt, ſecond, third, *&c. Place* above that of Units is Tens, Hundreds, Thouſands, *&c.* ſo the firſt, ſecond, third, *&c. Place* below that of Units, is *Tenths, Hundredths, Thouſandths*, decreaſing in tenfold Proportion, as is manifeſt from the following Table.

Millions.
Hundreds of Thouſands.
Tens of Thouſands.
Thouſands.
Hundreds.
Tens.
Units.

Tenth Parts.
Hundredth Parts.
Thouſandths.
Ten Thouſandths.
Hundred Thouſandths.
Millionths.

So	.5	ſignifies	5	Tenths.
	.25		25	Hundredths.
	.175		175	Thouſandths.

Cyphers ſet after Decimals do not alter their Value, as .8 and .8000 are the ſame, *viz.* only 8 Tenths: But when Cyphers are ſet before Decimals, they remove them farther from the Decimal Point, and therefore decreaſe them, as .08 is leſs than .8, ſo .0008 is leſs than .008, conſequently, each removal of a Figure into a Place forward makes it ten Times leſs than it was before.

To reduce Vulgar Fractions into Decimals.

RULE.

Add as many Cyphers to the Numerator as you intend Decimals, and divide by the Denominator, the Quotient is the Decimal required.

EXAMPLES.

1. Reduce $\frac{1}{4}$ of any Thing into a Decimal.

4)1 00(.25 the Decimal.
8
——
20
20
——

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2. Reduce $\frac{1}{2}$ of any Thing into a Decimal.

2)1.0(.5 the Decimal.
1 0

3. Reduce $\frac{3}{4}$ of any Thing into a Decimal.

4)3.00(.75 the Decimal.
2 8

20
20

So the Quarter, Half, and three Quarters of any Thing are .25; .5; and .75 decimally.

4. Reduce $\frac{2}{7}$ into a Decimal.

7)2.000(.285 the Decimal of $\frac{2}{7}$.
1 4

60
56

40
35

5

5. Reduce $\frac{1}{32}$ into a Decimal.

32)1 000(.031
96

40
32

8

Note, Here I annexed three Cyphers to one, the given Numerator; as I intended to have three Places in Decimals, and there ariſe but two in the Quotient, I muſt ſupply ſuch Defect by prefixing as many Cyphers on the Left hand of the firſt Figure in the Quotient as there want Places; as in the Example above there is prefixed a Cypher to make the Quotient compleat, becauſe I annexed three Cyphers to the Numerator.

To find the Value of any Decimal Fraction.

RULE.

Multiply your given Decimal by the Parts of the next inferior Denomination that is equal to the Integer, the Decimal dotted off gives the Part thereof; and if there be any Remainder, multiply it by the next inferior Denomination, &c. till all is done.

EXAMPLES.

1. What is the Value of .875 of a Pound Sterling?

Thus £.875
20
s. 17,500
12
d. 6.000

Anſwer 17*s.* 6*d.*

2. What is the Value of .5875 of a Ton Weight?

Thus .5875 *Ton.*
20
11.7500
4
3.0000

Anſwer 11 *C.* 3 *Qrs.*

3. What is the Value of .3712 of a Hundred Weight?

Thus .3712 *C.*
4
———
1.4848
28
———
38784
9696
———
13.5744
16
———
34464
5744
———
9.1904 *Anſw.* 1 *Qr.* 13*lb.* 9.1904*oz.*

ADDITION of DECIMALS.

RULE.

LET the Numbers be placed according to their Value, as Units under Units, Tens under Tens, *&c.* in whole Numbers; and in Decimals, Tenths under Tenths, Hundredths under Hundredths, *&c.* then work as in whole Numbers, always remembering to make as many Places of Decimals in the Sum Total, as the greateſt Number thereof were in your Example.

EXAMPLES.

£	*Yards.*	
		818.4£
.584	48.94	6.97
.371	21.648	3.81
.281	6.5	.54
.846	19.8168	.61
.75	72.1108	1.82
.6	16.614	3.25
£ 3.432	185.6296	835.40
Or £3 8*s.* 7½*d.*	Or 185 *Yds.* 2 *Qrs.* 2 *Nails*	Or £ 835 8*s.*

SUBTRACTION.

SUBTRACTION.

Place your Numbers as directed in Addition, then work as in whole Numbers.

EXAMPLES.

From	.591	.6198	1.	54.
Take	.397	.1499	0.987	6.9843
Remains	.194	.4699	0.013	47.0157

MULTIPLICATION.

Work in Multiplication as in whole Numbers, always remembering to ſet off as many Decimals in the Product as there are Decimals both in your Multiplicand and Multiplier, and if you have not a ſufficient Number in your Product, then prefix as many Cyphers as you want.

EXAMPLES.

.3416	.4918
.0037	37
23912	34426
10248	14754
.00126392	18.1966

DIVISION.

Divide as if all were whole Numbers, annexing Cyphers to the Dividend if Need be; and when you have finiſhed the Operation, point off for Decimals ſo many Places as the decimal Parts uſed in the Dividend exceed thoſe of the Diviſor, and thoſe to the Left, if any, are whole Numbers.

If the Places in the Quotient are not as many as the above Rule requires, then ſupply the Defect with Cyphers on the Left-hand of the Quotient.

EXAMPLES.

EXAMPLES.

246)160.884(.654 Quotient.
1476

1328
1230

984
984

246)16.0884(.0654
1476

1328
1230

984
984

2.46)1608.84(654
1476

1328
1230

984
984

EXTRACTION of the SQUARE ROOT.

ANY Number multiplied into itſelf is ſaid to be ſquared, or the Square of that Number: Thus 6 multiplied into itſelf, or 6 x 6=36 the Square of 6, whence the following table.

Roots	1.	2.	3.	4.	5.	6.	7.	8.	9.
Squares	1.	4.	9.	16.	25.	36.	49.	64.	81.

RULES

RULE.

When any Number is given to be extracted, point it off in every other Place, beginning at Unity; then find the firſt Figure in the Root, whoſe Square ſhall be equal to, or neareſt leſs than the Figure or Figures to the firſt Point, and then ſubtract that Square from the firſt Point, and to the Remainder bring down the next Point, and call that the Reſolvend. Then double the Quotient or Root, and ſet it for a Diviſor on the Left-hand of the Reſolvend, and ſeek how oft the Diviſor is contained in the Reſolvend, reſerving always the Units Place, and put the Anſwer in the Quotient or Root, and alſo in the Units Place of the Diviſor, then multiply the Diviſor by the Figure laſt put in the Quotient or Root, and ſubtract the Product from the Reſolvend as in common Diviſion, and bring down the next Point to the Remainder, and this is the Reſolvend, and proceed as before till the Operation is finiſhed.

EXAMPLES.

What is the Square Root of 116964?

Firſt let it be pointed thus 116964, then find the neareſt Square Number to 11 the firſt Period, as 9, *&c.* Thus

```
    116964(342 Root
     9
    ----
  64)269 Reſolved.
     256
    ------
 682)1364 Reſolvend.
     1364
    ------
        0
```

```
  For 342
   by 342
  -------
      648
     1368
    1026
  -------
   116964 Proof
```

What is the Square Root of 13169641 ?

Thus, $1\dot{3}1\dot{6}9\dot{6}4\dot{1}$ (3629 Root.
9
66)416
396
722)2096
1444
7249)65241
65241
0

When any whole Number is propoſed to extract the Square Root, and there be a Remainder, the Root may be found to any Degree of Exactneſs, by adding two Cyphers to the Remainder, and proceeding as before.

What is the Square Root of 37468 ?

$\dot{3}7\dot{4}6\dot{8}$ (193.566, &c.
1
29)274
261
383)1368
1149
3865)21900
19325
38706)257500
232236
387126)2526400
2322756
203644, &c.

When a mixt Number or Decimal is to be extracted, point every other Figure as before, beginning at the Units Place in whole Numbers; but in the Decimal always begin in the ſecond or hundreds Place, and if you have not a full Period, then add a Cypher to compleat it, and when you have not as many Figures in the Root as Dots or Periods, then prefix a Cypher or Cyphers to anſwer them.

What is the Square Root of 523.176?

$\dot{5}2\dot{3}.1\dot{7}6\dot{0})22.87$, *&c.*
4

42)123
84

448)3917
3584

4567)33360
31969

1391, *&c.*

What is the Square Root of .143219?

$.1\dot{4}3\dot{2}1\dot{9}(.3784$, *&c.*
9

67)532
469

748)6319
5984.

7564)33500
30256

3244, *&c.*

What is the Square Root of 7?

```
      7.000000(2.645, &c.
      4
      -------
  46)300
      276
      -------
 524)2400
        2096
        -------
 5285)30400
         26425
         -------
          3975, &c.
         -------
```

What is the Square Root of .0007612816?

```
      .0007612816(.02759
          4
      -------
   47)361
        329
      -------
    545)3228
           2725
         -------
    5509)50316
            49581
         -------
              735
         -------
```

To find the Square Root of a Vulgar Fraction, reduce it into a Decimal, and extract the Square Root of that Decimal, and the thing is done.

What is the Square Root of $\frac{4}{8}$ or $\frac{1}{2}$?

Thus $\frac{4}{8}$ or $\frac{1}{2}$ in Decimals is .5 then .5000(.707, &c.

```
              49
            ----
      1407)10000
            9849
            ----
             151, &c.
            ----
```

To extract the Cube Root.

RULE.

Firſt point off from the Unity Place every *third* Figure, find the firſt Figure in the Root by the following Table, ſubtract it from the firſt Period, augment the Remainder by the firſt Figure in the next Point, this call the Dividend; divide this Dividend by the triple Square of the whole Root laſt found, the Quotient Figure found annex to the Root; Cube the Root thus found, and ſubtract it from as many Points as you have brought down; to the Remainder bring down the firſt Figure of the next Point for a new Dividend, divide this new Dividend by the triple Square of the Root, the Quotient Figure annex to the Root again, Cube the whole Root, and ſubtract it from as many Points as you have brought down, and proceed in this manner till the Work is ended.

The TABLE of POWERS.

Roots	1	2	3	4	5	6	7	8	9
Squares	1	4	9	16	25	36	49	64	81
Cubes	1	8	27	64	125	216	343	512	729

Thus to extract the Cube Root of 13312053, the Number is firſt to be pointed after this manner, *viz.* 13312053, then you are to write in the Root the Figure 2, whoſe Cube 8 is the next leſs Cube to the Period 13, which is not a perfect Cube Number, and having ſubtracted that Cube according to the Rule, there will remain 5, which being augmented by the next Figure of the Reſolvend 3, and divided by the triple Square of the Root 2 or 12, by ſeeking how oft 12 is contained in 53, it gives 4 for the ſecond Figure of the Root, but ſince the Cube of 24, *viz.* 13824 would come out too great to be ſubtracted from 13312 that preceeds the ſecond Point there muſt only 3 be wrote in the Root, then 23 Cubed is 12167 which taken from 13312 will leave 1145, which augmented by the next Figure of the Reſolvend 0, and divided by the triple Square of the Quotient 23, *viz.* 1587, it gives 7 for the third Figure of the Root; then 237 Cubed and ſubtracted from the three Periods or the whole Reſolvend, there remains 0. Whence the true Root is 237.

EXAMPLES.

13312053(237 Root.
8

2 × 2=4 × 3=12)53(4 or 3.

Subtract Cube 12167

23 × 23=529 × 3=1587(11450(7

Subtract Cube 13312053

Remains 0

What is the Cube Root of 27054036008?

27054036008(3002 Root.
27

3 × 3=9 × 3=27) 0542(2

3002 Cubed is 27054036008

0

What is the Cube Root of 122615327232 ?

122615327232(4968 Root.
64

4 × 4=16 × 3=48)586(9

49 Cubed, Subtract 117641

49 × 49=2401 × 3=7203)49743(6

Subtract 496 Cubed, *viz.* 122023936

496 × 496=246016 × 3=738048)5913912(8

Subtract the Cube of 4968, *viz.* 122615327232

Remains 0

When the Reſolvend has a Remainder, you may carry on the Root to any Degree of Exactneſs, by adding 3 Cyphers for each new Period you intend to carry the Root to in Places of Decimals; and always remember to point off every third Figure from the Tenths Place in Decimals, the whole Numbers as before.

What is the Cube Root of 61218.00121 ?

61218.001210(39.41 Root
27

3 × 3=9 × 3=27)342(9

39 Cubed 59311

39 × 39=1521 × 3=4563)19070(4

394 Cubed 61162984

394 *Sqd.*=155236 × 3=465648)550172(1

3941 Cubed, is 61209566621

Remainder 8434589

What is the Cube Root of .0069761218 ?

.006976121800000(.19107
1
1 × 1=1 × 3=3)59(9
19 Cubed 6859
19 × 19=361 × 3=1083) 1171(1
191 Cubed 6967871
191 × 191=36481 × 3=109443) 82508(0
1910 Cubed 6967871000
1910 *Sqd.*=3648100 × 3=10944300)82508000(7
19107 Cubed, is 6975534818043
Remainder 586981957

CHAP. II.

Of GEOMETRY.

Sect. 1. *Geometrical Definitions.*

1. GEometry is a Science which teaches and demonſtrates the Properties, Affections, and Meaſures of all Sorts of Magnitudes.

2. Magnitude is continued Quantity, or any Thing that is extended; as a Line, Surface, or Solid, the Extremities of which are called Terms or Bounds; the Terms of a Line are Points; the Terms of a Superfice, or Plane, are Lines; and the Terms of a Solid are Planes.

3. A Point is the ſmalleſt Dot that can be made with a ſharp pointed Inſtrument; but, when mathematically conſidered, it is infinitely ſmaller, and may be eſteemed the naſcent Increment of Magnitude without Terms.

4. A Line is Length without Breadth or Thickneſs. A right Line is that which lies evenly, or in the ſame Direction between its Extremities: A curve Line continually changes its Direction. Hence there can only be one Sort of right Lines, but an infinite variety of Curves.

5. Parallel Lines are thoſe which are always at the ſame Diſtance from one another.

6. An Angle is the Inclination of two Lines to one another, meeting in a Point called the Angular Point. When it is formed by two right Lines, it is a Plane Angle; if by curve Lines, a Curvilineal Angle; if by a right Line and a curve Line, it is called a Mixed Lined Angle.

7. When a right Line ſtanding on another right Line makes Angles on either Side thereof equal between themſelves, each of theſe Angles will be a right one, or equal to 90d. and that Right-line which ſtands upon the other is called a Perpendicular to that on which it ſtands.

8. But if a Right-line ſtanding on another, be not perpendicular to it, the two Angles formed will be unequal; that which is greater than a Right-angle, is called an Obtuſe-angle, and that which is leſs an Acute-angle.

9. A Surface is that Magnitude which hath only Length and Breadth.

10. A Figure is that which is contained under one or more Sides, or Lines.

11. A Circle is a plane Figure, contained under one Line, called the Circumference; to which all Right-lines drawn from a certain Point within the Figure, are equal, and that Point is called the Centre of the Circle.

12. A Diameter of a Circle is a Right-line drawn through the Centre, terminated on both Ends by the Circumference, dividing the Circle into two equal Parts: Half of the Diameter is called the Radius.

13. A Segment of a Circle is a Figure contained under a Right-line, called the Chord, and the Part of the Circle's Circumference cut off by that Right-line: If that Right-line be the Diameter, the Segment will be a Semi-circle.

14. Right-lined Figures are ſuch as are contained under Right-lines.

15. Three ſided Figures are ſuch as are contained under three Lines; and theſe are called Triangles.

16. Four-ſided Figures are ſuch as are contained under four Lines.

17. An Equilateral Triangle is a Figure contained under three equal Right-lines.

18. An Iſoſeles, or Equicrural Triangle, is that which hath two equal Sides.

19. A Scalene Triangle is that which hath three unequal Sides.

20. A Triangle having two Sides perpendicular to each other, which contain a Right-Angle, is called a Right-Angled Triangle.

21. An Obtuſe Angled Triangle is that which hath one Obtuſe-Angle, being greater than a Right-Angle.

22. An Acute-Angled Triangle is that which hath three Acute-Angles, all leſs than Right-Angles.

23. A Square is a Figure contained under four equal Sides, and its Angles are all Right ones.

24. A Parallelogram, or Oblong, is a quadrilateral or four-ſided Figure, whoſe oppoſite Sides are parallel and equal to each other, and its Angles, all Right ones.

25. A Rhombus is a quadrilateral Figure, having four equal Sides, but no Right-Angles.

26. A Rhomboides is a quadrilateral Figure, whoſe oppoſite Sides and Angles only are equal.

27. All quadrilateral Figures, except theſe, are called Trapeziums.

28. A Trapezoid is a Quadrangle, having only two Sides parallel.

29. A Polygon is a plane Figure, incloſed by many right Lines. If all the Sides and Angles are equal, it is called a regular Polygon, and denominated according to the Number of its Sides, as a Pentagon, five Sides; a Hexagon, ſix; an Heptagon, ſeven; an Octagon, eight, *&c.*

30. Like or ſimilar Figures, are thoſe whoſe ſeveral Angles are equal to one another; and the Sides about the equal Angles proportional.

31. Homologous Sides of two Figures, are thoſe between two Angles reſpectively equal.

32. The Perimeter, or Circumference of a Figure, is the Compaſs of it, or Sum of all the Lines that encloſe it.

33. The internal Angles of a Figure are thoſe on the Inſide, made by the Lines that bound the Figure.

34. The external Angle of a Figure, is the Angle made by one Side of the Figure, and the adjoining Side continued or drawn out.

35. Parallel Right-lines are ſuch in the ſame Plane, which, if infinitely produced both Ways, would never meet.

36. The Diagonal, in a quadrilateral Figure, is a Line drawn from one Angle to its oppoſite Angle.

37. The Baſe of a Figure is the Line it is ſuppoſed to ſtand on.

38. The Altitude, or Height of a Figure, is the perpendicular Diſtance between the Baſe and the Vertex, or Part moſt remote from the Baſe.

39. A Propoſition is ſomething propoſed to be conſidered; and requires either a Solution or Anſwer, or that ſomething be explained or proved.

40. A Problem is a practical Propoſition, in which ſomething is propoſed to be done, or effected.

41. A Theorem is a ſpeculative Propoſition, or Rule, in which ſomething is affirmed to be true.

42. A Corollary is ſome Concluſion deduced from a preceding Propoſition.

43. A Scholium is a Remark on ſome Propoſition, or an Exemplification of the Matter contained in it.

44. An Axiom is a ſelf-evident Truth, or Principle, to which every one, on hearing it propoſed, muſt give his Aſſent.

45. A Poſtulate is a Principle or Condition requeſted, the Reaſonableneſs of which cannot be denied.

46. A Secant Point is where two Lines, or Arches, croſs each other.

POSTULATES.

1. That a Right-line may be drawn from any one Point to another.

2. That a finite Right-line may be continued or lengthened at Pleaſure.

3. That from a given Point, and with any Radius, a Circle may be deſcribed.

AXIOMS.

1. Things equal to one and the ſame Thing are equal to one another.

2. If to equal Things, are added equal Things, the Sums or Wholes will be equal.

3. If from equal Things equal Things be taken away, the Remainders will be equal.

4. If equal Things be added to unequal Things, the Sums or Wholes will be unequal.

5. If equal Things be taken from unequal Things, the Remainders will be unequal.

6. Things which are double to one and the ſame Thing, are equal to one another.

7. Things which are the half of one and the ſame Thing, are equal between themſelves.

8. Things which mutually agree together are equal to one another.

9. Equal Circles have equal Radii.

Explanation of Marks and Abbreviations.

$=$ Equality, or equal to, as 4×2 is $= 6$.
$+$ More, or added, $2 + 6$ is $= 8$.
$-$ Leſs, or ſubtracted from, as $5 - 2$ is $= 10$.
$\times$ Multiplied by, as 5×2 is $= 10$.
$\div$ To be divided by, as $\frac{8}{2}$ is $= 4$.
$\backsim$ The Difference, or Exceſs.
$>$, $<$'s Angle, Angles.
A^2 ſignifies the Square of A, and A^3 the Cube of it.
$\triangle$, $\triangle$'s Triangle, Triangles.
R, or Rad. Radius, or $\frac{1}{2}$ the Diameter of a Circle.
Comp. Complement, Completion.
Perp. or $\perp$ Perpendicular.
d. or def. Definition.
Supl. Supplement, or the Defects ſupplied.
$\oplus$ In Ship-building, ſignifies dead flat. See Plate 1ſt, Fig. A.

Sect. II. GEOMETRICAL PROBLEMS.

Problem 1. *To biſect or divide a Right-line given, as* A B, *into two equal Parts. Plate* 1, *Fig.* 1.

1. Set one Point of the Compaſſes in A, and with any Radius greater than half A B, deſcribe two Arches, one above and the other below the given Line. Then ſetting the Point of the Compaſſes in B, with the ſame Radius as before, deſcribe two more Arches, to make the ſecant Points C, D

2. Lay a Ruler on the ſecant Points, and draw the Line C D, which will divide the Line A B into two equal Parts, as was required.

Problem 2. *From a given Point, as* B *in or near the Middle of a given Line* A F, *to draw a Line perpendicular to the given Line. Plate* 1, *Fig.* 2.

1. Set one Point of the Compaſſes in B, open them to any convenient Radius leſs than B A or B F, and turning about the other Point, make the Marks E and C.

2. From E and C, with any convenient Radius, greater than B C or B E, deſcribe the ſecant Point D.

3. From the Point B, through the ſecant Point, draw the Right-line B D, which will be the Perpendicular required.

Problem 3. *From a given Point, as* B *at or near the End of a given Line* A F, *to draw another Line perpendicular to it. Plate* 1, *Fig.* 3.

1. Take at Pleaſure any convenient Point, as C, place one Foot of the Compaſſes in the ſaid Point, and extend the other to B, and with that Radius deſcribe the Arch E B D, cutting the given Line in B and D.

2. Through D and C draw the Right-line D C E, cutting the Arch B D E in E.

3. Through B and E draw the Right-line B E, which is the Perpendicular required.

Problem 4. *To biſect a given right-lined Angle, as* A B C, *Plate* 1. *Fig.* 4.

1. Set one Foot of the Compaſſes in B, and with any convenient Radius deſcribe the Arch A C.

2. From A and C, with one and the ſame Radius, deſcribe the Secant Point D.

3. Draw a Right-line through B and D, which will biſect, or divide the given Angle into two equal Parts, as was required.

Problem 5. *To draw a Line perpendicular to a given Line* A B, *that ſhall paſs through a given Point* C, *ſituated without the Line, and near the Middle of it. Plate* 1. *Fig.* 5.

1. Set one Point of the Compaſſes in the given Point C, and with any convenient Radius, deſcribe the Arch D F, cutting the given Line in D and F.

2. From D and F, with one and the ſame Radius, deſcribe the Secant Point E.

3. Lay a Ruler on the given Point C, and the Secant Point E, and draw the Line, the Perpendicular required.

Problem 6. *To draw a Line perpendicular to a given Line* A B, *that ſhall paſs through an aſſigned Point, nearly over the End of the given Line. Plate* 1. *Fig*. 6.

1. Draw from the given Point C, a Right-line at pleaſure, to cut the given Line A B, as in D.

2. Biſect the Right-line C D in E, by Problem 1.

3. Set one Foot of the Compaſſes in E, and with the Radius E C, deſcribe the Arch C G D, cutting A B in G.

4. Through C and G, draw the Right-line C G, the Perpendicular required.

Problem 7. *To make at a Point* D, *a Right-lined Angle, equal to a given Right-lined Angle* A B C. *Plate* 1. *Fig*. 7.

1. Draw the Line D F at pleaſure.

2. From B and D, with the ſame Radius, deſcribe the Arches A C, E F.

3. Take the Diſtance A C in the Compaſſes, and lay it on the Arch E F, from F to E.

4. Draw the Right-lines D E, D F, which will form the Angle F D E, equal to the given Angle A B C, as was required.

Problem 8. *To draw a Line as* D E, *parallel to a given Right-line* A B. *Plate* 1. *Fig*. 8.

1. On the given Points A and B, with the Diſtance requiſite between the two Lines, deſcribe the Arches D and E.

2. Lay a Ruler to touch the Top of the Arches, and by it draw the Line D E, which will be parallel to the given Line AB, as was required.

Problem 9. *To draw a Line parallel to a given Line* A B, *which ſhall paſs through a Point aſſigned as* C. *Plate* 1. *Fig.* 9.

1. Set one Foot of the Compaſſes on any Point, as D, in the Line A B, and with the Radius D C, cut A B in E.

2. On E, with the ſame Radius, deſcribe the Arch F.

3. Set one Foot of the Compaſſes in C, and with the ſame Radius as before, deſcribe the Arch D F, cutting the former in F.

4. Draw through C and F, the Right-line C F, which will be parallel to the given Line AB, and paſs through the Point C, as was required.

Problem 10. *Upon a given Right-line, as* A B, *to deſcribe a Squar. Plate* 1. *Fig.* 10.

1. Draw BC, perpendicular and equal to A B.

2. Set one Foot of the Compaſſes in B, and with the Radius B A, deſcribe the Arch D E B. And on C, with the ſame Radius, deſcribe the Arch cutting the former in D.

3. From the Secant Point D, draw Lines to the Points C and A; and the Figure A B C D will be the Square required.

Problem 11. *To deſcribe a Circle, whoſe Circumference ſhall paſs through three given Points, as* A B C, *provided they are not ſituated in one Right-line. Plate* 1. *Fig.* 11.

1. Biſect the Diſtance C B, with the Line D E; that is, ſet one Point of the Compaſſes in C, and with any convenient Radius, greater than half B C, deſcribe two Arches; and removing the Point of the Compaſſes to B, with the ſame Radius as before, deſcribe two other Arches, cutting the former in D and I, and draw the Right-line E D.

2. In the ſame Manner biſect the Diſtance B A, with the Line F C. Where theſe two Lines interſect each other, as at H, is the Center of the Circle.

3. On H, the Center, with the Diſtance to either of the given Points deſcribe the Circle, which will paſs through the given Points, as was required.

Problem 12. *To divide a given Line, as* A B, *into any propoſed Number of equal Parts. Plate* 1. *Fig.* 12.

1. From the Extremities A and B, make by Problem 7 two equal Angles, as A B F and E A B.

2. In each of the Lines A E, B F, beginning at A and B, ſet off as many equal Parts as the given Line A B is required to be divided into, *viz.* 1, 2, 3, 4, 5, 6.

3. Draw Lines from 6 to B; 5 to 1; 4 to 2, *&c.* which will divide the given Line A B, as was required.

This Problem may alſo be performed as follows.

1. Through one End, as A, *Fig.* 13, draw a Line C C, nearly perpendicular to A B.

2. Draw at any convenient Diſtance E F parallel to A B.

3. In E F take any Length, and ſet off as many equal Parts as A B is to be divided into; as 1, 2, 3, 4, 5, 6, to F.

4. Through B and F, where the Diviſions terminate, draw B C.

5. Draw Lines from C, through the ſeveral Diviſions of E F, which will cut A B into the equal Parts required.

But it is neceſſary to obſerve, that if the Diviſions from E to F happen to be leſs than A B, the Point C, and the Line B F, will be on the ſame Side of A B; but if greater, C falls on the contrary Side. Thus a Scale of equal Parts may be made as in *Plate* 3, *Fig.* 14.

Problem 13. *On a given Line, as* A B, *to conſtruct a regular Polygon of any aſſigned Number of Sides. Plate* 1, *Fig.* 15, 16.

1. Divide 360 Degrees by the Number of Sides; ſubtract the Quotient from 180 Degrees, the Remainder will be the Degrees which meaſure the Angle made by any two adjoining Sides of that Polygon, and is called the Angle of the Polygon.

2. At the Ends A B, of the Line B A, make Angles A B C, B A D, equal to the Angle of the Polygon.

3. Make A D, B C, each equal to A B.

4. At the Points C D, make Angles equal to that of the Polygon as before; and let the Sides including thoſe Angles be each equal to A B; and thus proceed until the Polygon is conſtructed.

In Figures of any Number of Sides, the two laſt D E, C E, are readieſt found by deſcribing Arches from C and D, with the ſame Radius A B interſecting in E.

In Figures of an even Number of Sides, having drawn half the Number, by Means of the Angles; the remaining Sides may be found by drawing Lines parallel and equal to their oppoſite Sides.

Problem 14. *To deſcribe an Ellipſis.*

The Ellipſis is one of the Conic Sections, and is a Figure contained within a ſingle Curve Line, and having two unequal Axes or Diameters, as A B and D E. *Fig.* 17. The greater Axis of the Ellipſis, or the Right-Line, A B, repreſenting the Length of the Ellipſis, is called the Tranſverſe Axis, or Diameter; and the leſſer Axis D E repreſenting the Breadth of the Ellipſis, the Conjugate, or Second Axis. Theſe two Diameters alſo biſect each other at Right-Angles, in C the Center of the Ellipſis.

The two Points F, *f*, in the Traverſe Diameter, equally diſtant from the Extremes thereof A and B, are called the Foci, of the Ellipſis; from which if two Lines be drawn as F H; *f*, H, to the Circumference of the Ellipſis, they are equal to the Tranſverſe Diamenter, or longer Axis.

The Right-Line F E, drawn from the Focus F, to the Extremity of the Conjugate Semi-axis, is equal to half the Tranſverſe Axis A C B. Hence the Conjugate Axis being given, the Foci are eaſily determined. For, biſecting the greater Axis A B in C; from C erect a Perpendicular C D, equal to the Conjugate Semi-Axis; then from D, with the Interval C A, the Foci F and *f*, are determined.

Becauſe the Sum of the two Right-lines F E and *f* E, or F H, *f* H from each Focus F and *f* of an Ellipſis to the ſame Point of the Periphery E, is equal to the greater Axis A B, the Ellipſis, when the Conjugate Axis is given, may be eaſily deſcribed by finding a Number of Points through which the Circumference muſt paſs: Or two Nails or Pins being fixed in the Foci, tie about them a Thread F E *f*, equal to the Length of the Tranſverſe Diameter A B; apply a Pencil or Pin to its Extent, ſtretching the Thread, and carry the Pin gently round, it will deſcribe the Curve of the Ellipſis. —— N. B. *The Foci in the Figure ought to be placed nearer the Periphery in the Tranſverſe Diameter.*

Sect. III. GEOMETRICAL THEOREMS.

Theorem 1. *When one Right-Line, as* C D, *ſtands upon another Right-Line, as* A B, *they form two Angles* B C D, A C D, *which together are equal to two Right-Angles. Plate* 1, *Fig.* 18.

DEMONSTRATION.

On C, as a Center, deſcribe the Semi-Circle A D B: Then is the Arch D B, the Meaſure of the Angle D C B; and the Arch D A the Meaſure of the Angle D C A: But the Arch A D + the Arch D B, is equal to 180 Degrees, or two Right-Angles Q. E. D.

COROLLARY.

Hence, if ever ſo many Right-Lines, as C D, C *d*, *&c.* ſtand on one Point C, on the ſame Side of another Right-Line A B; the Sum of all the Angles are equal to 180 Degrees, or two Right-Angles.

Theorem 2. *If two Right-lines, as* A C, E B, *interſect each other, as in* D, *the oppoſite Angles are equal,* viz. *the Angle* C D B = *the Angle* A D E, *and the Angle* C D E = *the Angle* A D B. *Plate* 1. *Fig.* 19.

DEMONSTRATION.

Becauſe the Angle A D E + the Angle A D B = two Right-Angles. And the Angle C D B + the Angle A D B = two Right-Angles. Therefore the Angle A D E + the Angle A D B = the Angle C D B + the Angle A D B. Conſequently the Angle A D E = the Angle C D B.

COROLLARY.

Hence if ever ſo many Right-lines interſect each other in the ſame Point, the Sum of all the Angles formed by them about that Point is equal to 360 Degrees, or four Right-Angles.

Theorem 3. *If a Right-line, as* F E, *cut two parallel Lines, as* A B *and* C D, *the outward Angle* a *will be equal to the inward and oppoſite Angle* d; *and the alternate Angles will be alſo equal. And* vice verſa. *Plate* 1, *Fig.* 20.

DEMONSTRATION.

Becauſe C D and A B are by Suppoſition parallel, therefore F E has the ſame Inclination to C D and A B. But this Inclination is expreſſed by the Angle *a*, or the Angle *d*. Conſequently the outward Angle *a* is equal to the inward and oppoſite Angle *d*. But the Angle *a* is equal to the Angle *c*; and the Angle *a* is equal to the Angle *d* (by the preceding Theorem:) Conſequently the alternate Angles *c* and *d* are equal.

Theorem 4. *In any Right-lined Triangle, as* A B C, *the Sum of the three Angles,* a, b, c, *is equal to* 180 *Degrees, or two Right-Angles. And if one Side of the Triangle, as* B C, *be continued, the outward Angle* f *will be equal to the Sum of the two inward and oppoſite Angles* a *and* b. *Plate* 1, *Fig.* 21.

DEMONSTRATION.

Draw, through the Point A, a Right-line parallel to B C. Then will the Angle *e* +, the Angle *a* +, the Angle *d*, = 180 Degrees, or two Right-Angles. And by the laſt Theorem, the Angle *e* = equal the Angle *b*; and the Angle *d* = the Angle *c*. Therefore the Angle *b* + the Angle *a* + the Angle *c* = the Angle *e* + the Angle *a* + the Angle *d*. Conſequently the Angle *b* + the Angle *a* + the Angle *c* = 180 Degrees, or two Right-Angles. Alſo becauſe the Angle *c* + the Angle *f* = 180 Degrees. Therefore the Angle *f* = the Angle *a* + the Angle *b*.

COROLLARIES.

1. Hence the two acute Angles of every Right-angled Triangle are equal to 90 Degrees; and therefore if one of them be given, the other is alſo known, being equal to the Complement of the other, or what the other is leſs than a Right-Angle.

2. The Sum of three Angles of any Triangle is equal to the Sum of the three Angles of any other Triangle.

3. I

3. If one Angle of any Plane Triangle be given, the Sum of the other two Angles is known, being equal to the Difference between the given Angle, and 180 Degrees.

Theorem 5. *Parallelograms, as* AD, Da, *ſtanding on the ſame Baſe as* CD, *or equal Baſes, and between the ſame Parallels as* Ab, CE, *are equal. Plate* 3, *Fig.* 22.

DEMONSTRATION.

Becauſe $AB = CD = ab$; therefore $Aa = Bb$, for Ba is common to both. And becauſe $AC = BD$, as the Angle $A =$ the Angle C, therefore the Triangle $ACa =$ the Triangle BDb; and if from both the Triangles there be taken the Triangle Bxa, common to both, there will remain the Trapezium $ABxC =$ the Trapezium $abDx$. But the Trapezium $ABxC +$ the Triangle $CxD =$ the Parallelogram $ABCD$. And the Trapezium $abDx +$ the Triangle $CxD =$ the Parallelogram $abCD$. Conſequently the Parallelogram $ABCD =$ the Parallelogram $abCD$.

COROLLARY.

Hence all Triangles ſtanding upon the ſame Baſe, or upon equal Baſes, and between the ſame Parallels are equal: For all Triangles are the Halves of their circumſcribing Parallelograms; and therefore if the Wholes are equal, their Halves will be alſo equal.

Theorem 6. *In any Right angled Triangle, as* ABC, *the Square of the Hypothenuſe, as* AC, *is equal to both the Squares of the Sides including the Right Angle, as* AB, BC. *Plate* 3, *Fig.* 23.

DEMONSTRATION.

Draw a Square, whoſe Side is AC; a Square whoſe Side is BC; and a Square whoſe Side is AB. Join BD, BE, AI, and CF, and draw BM parallel to CE.

Then the Angle $DAC =$ the Angle FAB. And by adding the Angle BAC, common to both, the Angle $BAD =$ the Angle FAC. Alſo, becauſe A B = A F, and A D = A C, by Conſtruction; therefore the Triangle B A D = the Triangle F A C. But the Parallelogram A M = twice the Triangle B A D (*by Corollary to Theorem* 5.) and (by the ſame) the Square A G = twice the Triangle A F C. Conſequently the Parallelogram A M = the Square A G.

And in the ſame Manner it may be proved that the Parallelogram C M = the Square C H. Therefore the Square A E = the Parallelogram A M + the Parallelogram C M = the Square A G + the Square C H.

COROLLARY.

Hence, from two given Sides of a Right-angled Triangle it will be eaſy to find the third; for if the two Sides containing the Right-angle are given, the Hypothenuſe, or Side ſubtending the Right-Angle, will be found by adding the Squares of the two given Sides together, and extracting the Square Root out of that Sum. Or if the Hypothenuſe, and one of the Legs be given, the Square of the given Leg being ſubtracted from the Square of the Hypothenuſe, the Square Root of the Remainder will be the Leg required.

CHAP III.

Of MENSURATION.

Sect. I. MENSURATION *of* SUPERFICIES.

Problem 1. *To find the Area of a Square, or Right-angled Parallelogram.*

RULE.

Multiply the Length by the Breadth, and the Product will be the Area required.

Example 1. *Suppoſe in the Square* g h i k, *that* g h, g k, h i, k i, *are all equal, and each contain* 120 *Inches; what is the Area of the Square? Plate* 2, *Fig.* 1.

Multiply ——— 120 the Length,
By ——— 120 the Breadth,

```
  2400
 120
 -----
 14400 the Content required.
```

And becauſe 144 Inches are equal to one Square Foot (for 12 × 12 = equal 144); therefore if the Area found above in Inches be divided by 144, the Quotient will give the Area in Feet, and Remainder the odd Inches.

By this Rule, all ſtrait Boards, whoſe Breadths at each End are equal, may be meaſured: But if broader at one End than at the other, it will be neceſſary to take the Breadth at both Ends, add them together, and take the Half for the true Breadth.

It will alſo be neceſſary to obſerve, that if the Breadth be given in Inches, and the Length in Feet, the Product muſt be divided by 12, and the Quotient will be the Content in Feet; the Remainder, if any, being multiplied by 12, will give the odd Inches.

Example 2. *Suppoſe a Plank or Board,* 20 *Feet long, and* 40 *Inches broad, what is its Area?*

```
     40
      20
   -------
   12)800(8
   -------
      66
```

Whence it appears that the Area of a Plank 20 Feet long, and 40 Inches broad, is 66 Feet, and the Remainder 8 multiplied by 12 gives 96 Inches.—If the Length of the Board had been firſt reduced into Inches, and then multiplied by the Breadth, and the Product divided by 144, the Anſwer would be the very ſame as above.

Problem 2. *To find the Area of a Rhombus or Rhomboides.*

R U L E.

Multiply the ſhorteſt Diſtance between the two longeſt Sides, by one of the ſaid Sides, and the Product will be the Area required.

Example. *Suppoſe* p t 130 *Inches, and the Diſtance or Perpendicular,* p y 108; *required the Area of the Rhombus* q a p t? *Plate* 2, *Fig.* 2.

Multiply ——— 130 the Length,

By ——— 108 the Breadth.

1040

1300

14040 Area required in Inches.

Or being divided by 144, we ſhall have 97 Feet, 72 Inches, the Area of the Rhombus.

Problem 3. *To find the Area of a Triangle.*

R U L E.

Becauſe every Triangle is the Half of its circumſcribing Parallelogram; therefore, in order to find its Area, we muſt multiply the Baſe by half the Perpendicular; or half the Baſe by the Perpendicular, and the Product will be the Area required.

Example. *Let* a b c, d c b, *repreſent a Triangular Superficies, whoſe Baſe,* a b, *or* d b *is* 260 *Inches, and the Perpendicular* 110 *Inches; required the Area. Plate* 2, *Fig.* 3.

Multiply ——— 260 the Baſe,

By ——— 55 half the Perpendicular.

1300

1300

14300 the Area required.

Problem 4. *To find the Area of a Trapezium.*

RULE.

In the Trapezium (*Plate* 2, *Fig*. 4.) draw the Line *a b*, and let fall the Perpendiculars *s e*, *c r*, which will divide the Trapezium into two Triangles, whoſe Areas may be found by the preceding Problem; and it is evident from the Figure, that thoſe Triangles are equal to the Trapezium. Or the Area may be found by one Operation, thus; multiply the Sum of the two Perpendiculars, *s e*, *c r*, by the half of *a b*; the Product is the Area of the Trapezium. This is ſo eaſy, that it needs no Example.

All other irregular Figures, conſiſting of more than four Sides, muſt be divided into Triangles, which will ever be leſs by 2 than the Number of Sides, and then the Areas of all thoſe Triangles will be equal to the Area of the whole Figure.

Problem 5. *To find the Area of a regular Polygon.*

RULE.

Multiply half the Sum of the Sides by the Perpendicular, and the Product will be the Area required.

Example. *Suppoſe in a regular Pentagon, each Side, as* d b *is* 26 *Inches, and the Perpendicular,* c a, 16 *Inches; what is the Area of the Pentagon? Plate* 2. *Fig*. 5.

Multiply ——— 65, half the Sum of the Sides,
By ——— 16, the Perpendicular.

390
65

1040 the Area required.

Problem 6. *To find the Area of a Circle.*

As it has hitherto proved an inſuperable Difficulty to determine the exact Proportion between a Right-line and a Curve; Mathematicians have been obliged to conſider a Circle as a Polygon of an infinite Number of equa

Sides; if therefore half the Sum of theſe be multiplied by half the Diameter or Radius, the Product will be the Area of the Circle, as in the preceding Problem. But before this can be done, the Circumference, or Sum of thoſe infinite Numbers of Sides of which it is ſuppoſed to be compoſed, muſt be found. This, when the Diameter is 1, is 3.1415926536 nearly. Therefore as 1 to 3,1416, ſo is the Diameter of any Circle to its Circumference, and *vice verſa*. And hence we may find the Area of the Circle by the following

RULE.

Multiply the Circumference by one-fourth of the Diameter, or half the Radius, and the Product is the Area required.

Example. *What is the Area of a Circle, whoſe Diameter is 20 Feet?*

As 1 : 3.1416 : : 20 : 62.832 the Circumference. Then
Multiply ——— 62.832 the Circumference
By ——— 5 half the Radius.

314.16 the Area required.

Problem 7. *To find the Area of a Sector.*

RULE.

Multiply the Length of the Arch by half the Radius, the Product will be the Content required.

Example. *Suppoſe the Radius* AB 28 *Inches, and the Arch* BDC 30 *Inches; required the Area of the Sector* ABDC? *Plate* 2. *Fig.* 6.

Multiply ——— 30 the Arch,
By ——— 14 half the Radius.

120
30

420 the Area required.

Problem

Problem 8. *To find the Area of the Segment of a Circle.*

RULE.

Draw Lines from the Center of the Circle to the two Extremities of the Arch of the Segment; find the Area of the Sector thus formed, as in the preceding Problem, and alſo the Area of the Triangle formed between the Chord of the Arch, and the Center of the Circle, by Problem 3. Then ſubtract the Area of the Triangle from the Area of the Sector, and the Remainder will be the Area of the Segment required.

Problem 9. *To find the Area of an Ellipſis.*

An Ellipſis is a Geometrical Mean between two Circles, whoſe Diameters are reſpectively equal to the Tranſverſe and Conjugate Diameters of the Ellipſis. Hence, to find the Area of any Ellipſis, we have the following general

RULE.

Multiply the Tranſverſe Diameter by the Conjugate, and extract the Square Root out of the Product, which Root will be the Diameter of a Circle, whoſe Area is equal to the Area of the Ellipſis.

Example. *Lot it be required to find the Area of an Ellipſis, whoſe Tranſverſe Diameter is 25, and its Conjugate 16?*

25
16

150
25

400(20 the Diameter of the Circle.
4

.00

Then as 1 : 3.14159, &c. : : 20 : 62.832 the Circumference; and the Area as before found, Prob. 6. is 314.16, which is equal to the Area of the Ellipſis required.

Before we conclude this Section, we ſhall explain the Method of finding the Area of Superficies by croſs Multiplication.

Example. *Let it be required to multiply* 47 *Feet* 8 *Inches, by* 9 *Feet* 4 *Inches.*

Ft.	Inch.	
47	8	
9	4	
423	0	
6	0	
15	8	
	2	8
444	10	8

In the foregoing Operation the 47 Feet in the Multiplicand, are multiplied by the 9 Feet in the Multiplier, and the Product is 423 Feet. Then the 9 Feet in the Multiplier are multiplied (croſs wiſe) by the 8 Inches in the Multiplicand, which gives 72 Inches, or 6 Feet. Next the 47 Feet in the Multiplicand are multiplied by the 4 Inches in the Multiplier; which produces 188 Inches, or 15 Feet 8 Inches. Laſtly, the Inches in both the Factors are multiplied together, and produce 32 Parts, *viz.* $\frac{32}{12}$, or two Inches, and 8 twelfths of an Inch. The Total of theſe ſeveral Products, gives 444 Feet 10 Inches, 8 Parts, which is the Product of 47 Feet 8 Inches, by 9 Feet 4 Inches.

Sect. II. MENSURATION of SOLIDS.

1. A Solid is that which hath Length, Breadth, and Depth, or Thickneſs. And as a Superficies is bounded by Lines, ſo a Solid is bounded by Superficies.

2. A Cube is a Solid, conſiſting of ſix equal Square Sides, in the Form of a Dye.

3. A Parallepiped is a Solid comprehended under ſix Parallelograms, the oppoſite ones whereof are ſimilar, parallel, and equal.

4. A Priſm is an oblong Solid, contained under more than four Planes, whoſe Baſes are equal, parallel, and like ſituated. It is generated by the Motion of a rectilinear Figure, as A B C (*Plate* 2. *Fig.* 7.) deſcending always parallel to itſelf along the Right-line A E. If the Deſcribent or Baſe be a Triangle, the Solid is ſaid to be a Triangular Priſm; if a Square, the Quadrangular one, *&c.* but if a Circle, it is called a Cylinder.

It is evident from the Geneſis of the Priſm, that it has two equal and oppoſite Baſes, that it is terminated by as many Parallelograms as the Baſe conſiſts of Sides, and that all the Sections of a Priſm, parallel to its Baſe, are equal.

5. A Pyramid is a Solid, ſtanding upon a Square, triangular, or polygonal Baſe, and terminating at its Top, or Vertex in a Point.

6. A Cylinder is a Solid, in form of a rolling Stone, being only a round Priſm, having its Baſes or Ends perfect Circles. It may be generated by the Revolution of a Parallelogram about one of its Sides, fixed as an Axis.

7. A Cone is a Solid whoſe Baſe is a Circle, from whence it gradually tapers to its Vertex, which terminates in a Point. It is generated by the Revolution of a Right-angled Triangle about one of its Legs, fixed as an Axis.

8. A Sphere or Globe, is a Solid contained under one ſingle curved Surface; being generated by the Rotation of a Semicircle about its Diameter, fixed as an Axis. Whence that Point, which was the Center of the generating Circle, becomes the Center of the Sphere or Globe itſelf, being equally diſtant from every Point in the generated Surface.

9. A Spheroid is a Solid, generated by the Revolution of a Semi-Ellipſis about its Axis. If the Rotation be performed about the Tranſveſe or longeſt Axis, it is called a Prolate or oblong Spheroid; but when it is generated by the Rotation of a Semi-Ellipſis about its conjugate or ſhorteſt Diameter, it is called an oblate Spheroid.

Having defined theſe Solids, it remains that we ſhew the Methods of finding their Solid Contents.

Problem 1. *To find the Solid Content of a Cube.*

R U L E.

Multiply the Length, Breadth, and Depth (which in this Solid are all equal) into one another, and the laſt Product is the Solid Content required.

Note, That 1728 Cubic Inches make one Cubic Foot; for 12 × 12 × 12 = 1728. Therefore when the Dimenſions are taken in Inches, the Solid Content will be alſo Inches, which may be brought into Feet, by dividing by 1728.

Example. *What is the Solid Content of a Cube, whoſe Length, Breadth, and Depth are each equal to 98 Inches?*

$$\begin{array}{r l} 98 & \text{Length.}\\ 98 & \text{Breadth.}\\ \hline 784 & \\ 882 & \\ \hline 9604 & \\ 98 & \text{Depth}\\ \hline 76832 & \\ 86436 & \\ \hline 941192 & \end{array}$$

Whence the Solid Content of the above Cube is 941192 Cubic Inches, or (by dividing by 1728) 544 Feet, 1160 Inches.

Problem 2. *To find the Solid Content of a Parallelepiped.*

R U L E.

Find the Area of the Parallelogram which conſtitutes its Baſe, and multiply it by the Height or Length, and the Product will be the Solid Content required.

Example. *Required the Solid Content of a Parallelepiped, when the Length of the Parallelogram which conſtitutes the Baſe, is 24 Inches, its Breadth 16 Inches, and the Height of the Parallelepiped 26 Inches.*

24 Length of the Baſe.
16 Breadth.

144
24

384 Area of the Baſe.
24 Height

1536
768

9216

Whence the Solid Content is 9216 Inches, or 5 Feet 576 Inches.

Problem 3. *To find the ſolid Content of a Priſm.*

R U L E.

Find the Area of its Baſe, and multiply it by the Height or Length, the Product is the ſolid Content required.

Example. *Required the ſolid Content of a ſquare Priſm, the Sides of whoſe Baſe are each 20 Inches, and the Height of the Solid 60 Inches.*

20
20

400 Area of the Baſe.
60 Height

24000

Whence it Area is 24000 Inches; or 13 Feet 1536 Inches.

Problem

Problem 4. *To find the ſolid Content of a Pyramid.*

R U L E.

Find the Area of the Baſe, multiply that Area by the Height, and divide the Product by three, the Quotient is the ſolid Content required; or, which is the ſame Thing, find the Area of the Baſe, and multiply it by one third of the Height.

Example. *What is the ſolid Content of a Pyramid, whoſe Baſe is a Square, each Side being 26 Inches, and the Height of the Solid 60 Inches?*

```
  26
  26
 ———
 156
 52
 ———
 676 Area of the Baſe.
  60 Height.
 ———
3)40560(13520
  .....
```

Or multiply the Area of the Baſe 676 by 20, one third of the Solid's Height, and we ſhall have 13520 Inches, the ſame as before, for the ſolid Content of the Pyramid.

Problem 5. *To find the ſolid Content of a Cone.*

R U L E.

Find the Area of the Circle which conſtitutes its Baſe, multiply this Area by the Height of the Cone, and divide the Product by 3, the Quotient is the ſolid Content required.—Or multiply the Area of the Baſe by one third of the Height, and the Product will be the Content.

Example. *The ſolid Content of a Cone, the Diameter of whoſe Baſe is 60 Inches, and its Height 108 Inches is required.*

The Area of the circular Baſe (found by Prob. 6. of Superficies) is,

2826.44
108 the Height.

2261152
2826440

3)305255.52

101751.84

Or by multiplying 2826.44 by 36, one third of the Height, the Product will be 101751.84, the Content of the Cone, the ſame as before, which may be reduced into Feet, if required.

Problem 6. *To find the ſolid Content of a Sphere, or Globe.*

RULE.

Find the Area of a Circle, whoſe Diameter is equal to that of the Diameter of the Sphere; multiply that Area by double the Diameter, and divide the Product by 3, the Quotient is the ſolid Content. Or, which is the ſame Thing, multiply the Area of the Circle by one third of double the Diameter of the Sphere, the Product is the Content.

Example. *Required the Solid Content of a Sphere or Globe, whoſe Diameter is 120 Inches.*

The Area of a Circle, whoſe Diameter is 120 Inches, found as in the preceeding Problem, is,

11309.76
240 double the Diameter.

45239040
2261952

3)2714342.40

904780.80

Or by multiplying 11309.76, by 80, one third of double the Diamete the Product will be 904780.80, the Solid Content of the Sphere require

Problem 7. *To find the Solid Content of a Spheroid.*

R U L E.

Find the Area of a Circle, whoſe Diameter is equal to the Conjugat Diameter of the Spheriod, multiply it by twice the Tranſverſe Diamete and divide the Product by 3, the Quotient is the Solid Content require For every Spheriod is equal to two-thirds of its circumſcribing Cylinder.

Example. *Required the Solid Content of a Spheriod, whoſe Tranſverſe Dia meter is 80 Inches, and its Conjugate 60?*

The Area of a Circle, whoſe Diameter is 60, will be found to be

2827.44
160 twice the Tranſverſe Diameter.

16964640
282744

3)452390.40

150796.8

Whence the Solid Content of the above Spheriod is 150796.8 Inches or 87.266, &c. Feet.

Problem 8. *To find the Solid Content of the Fruſtrum of a Cone.*

N. B. The Fruſtum of a Cone is a Part of that Solid cut off by Plane, generally parallel to its Baſe.

R U L E.

From the Square of the Sum of the Diameters at the Ends, take th Product of the Diameters; multiply the Remainder by the Fruſtum' Height, and that Product by 2618, gives the Content.

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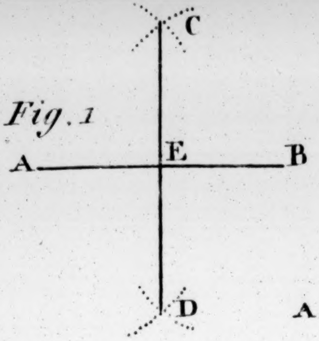
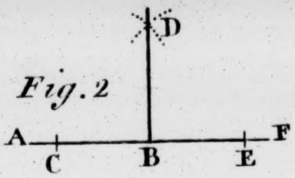


Fig. 1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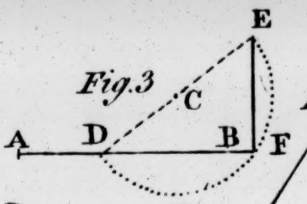
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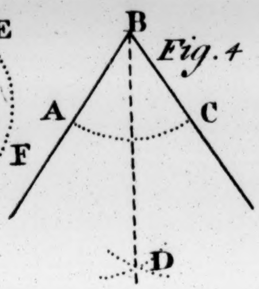
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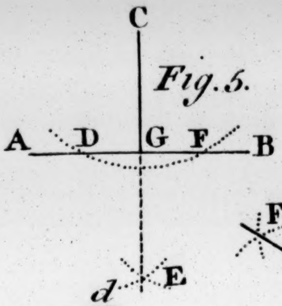
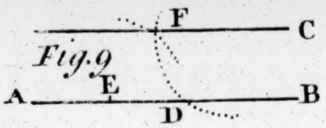


Fig. 5.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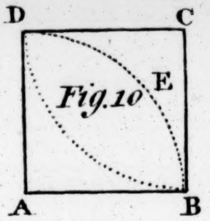


Fig. 10

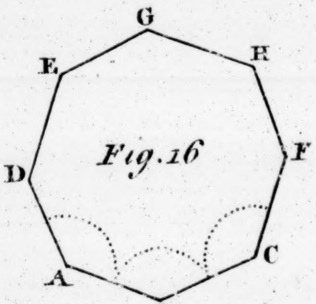


Fig. 16

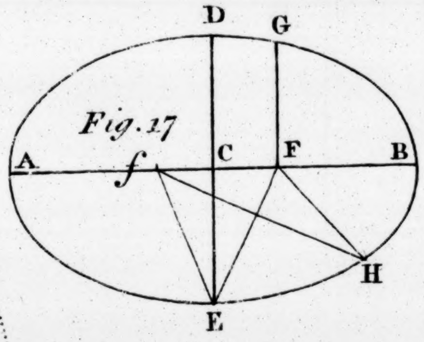


Fig. 17

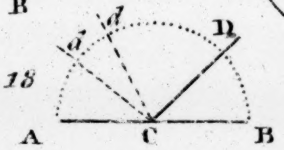
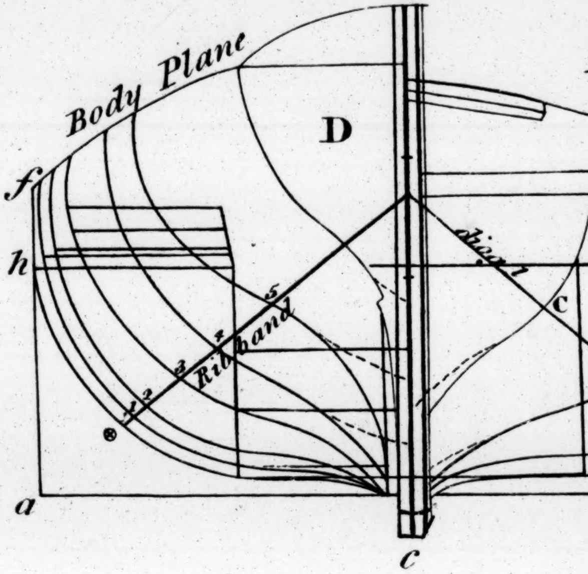
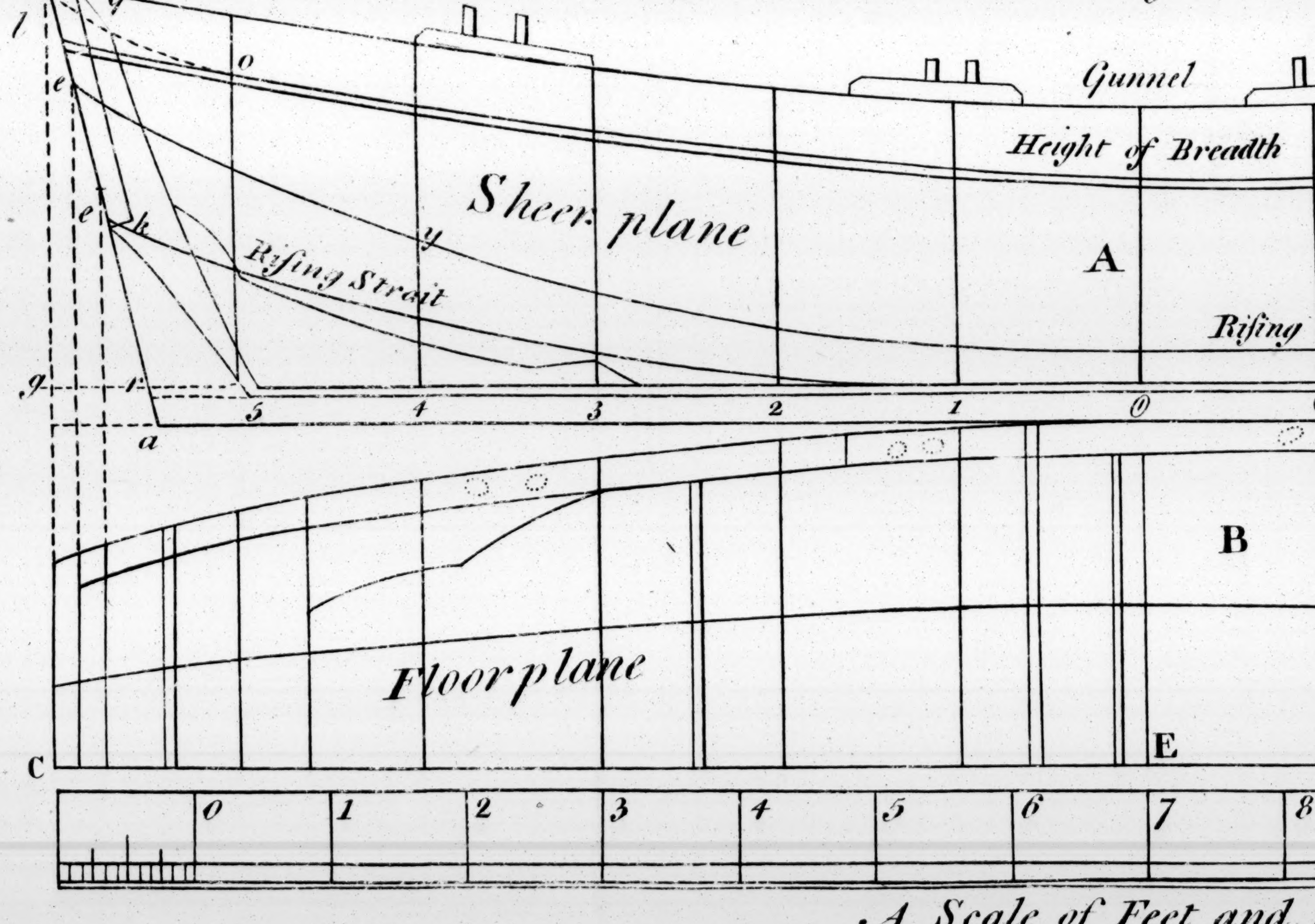


Fig. 18





A Scale of Feet and

Fig. 6.

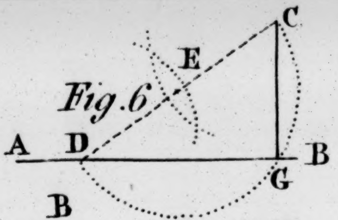


Fig. 7.

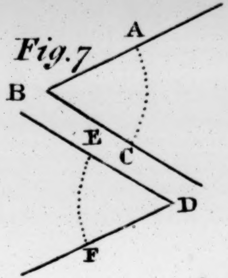


Fig 8

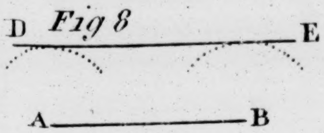


Fig. 11

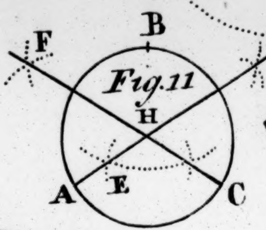


Fig. 15

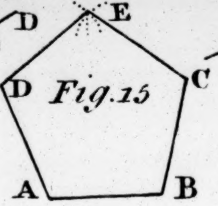


Fig. 12

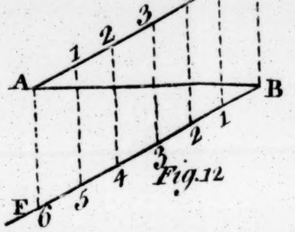
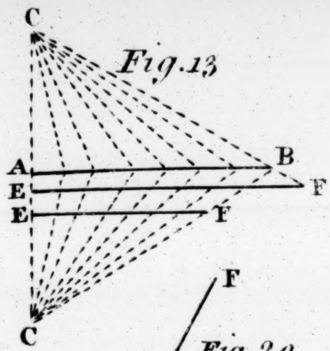


Fig. 13



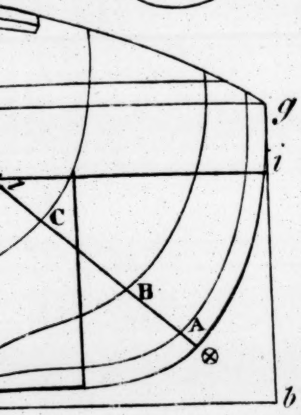


Fig. 10

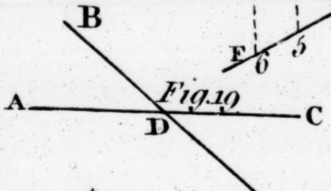


Fig. 20

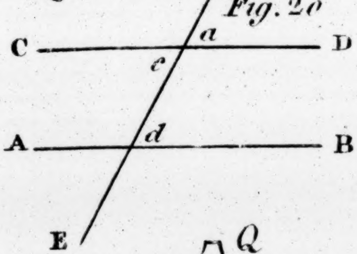
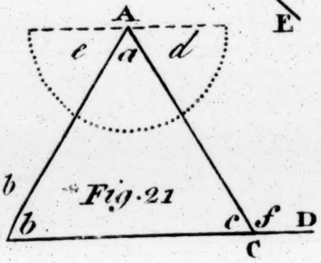
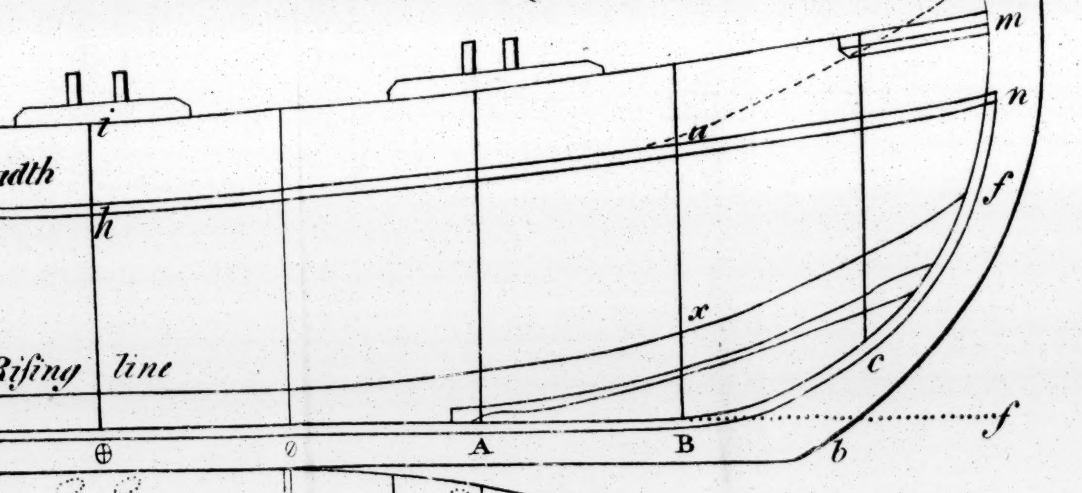
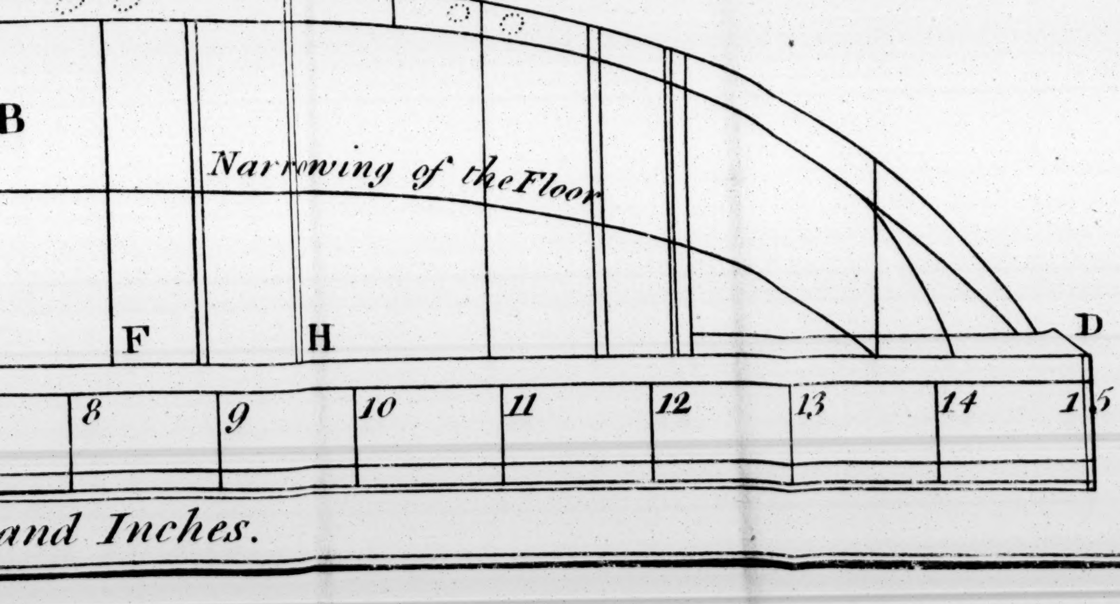


Fig. 21







and Inches.

Example. *Let the greater Diameter,* 30 Inches
the leſſer ditto 20 Inches

Sum 50 its Square - - 2500
Product - - - 600

Remainder - - - 1900
Fruſtum's Height - - 40

Product - - - - - 76000
× ,2618

Content - - 19896,8

Which divided by 1728 gives 11 Feet, and 888,8 Inches.

Problem 9. *To find the Content of the Fruſtrum of a Square Pyramid.*

RULE 1.

To the Rectangle of the Sides of the two Baſes, add the Sum of their Squares; that Sum being multiplied into one third of the Fruſtrum's Height gives the Solidity.

RULE 2.

To the Rectangle of the Sides of the two Baſes, add one Third of the Square of their Difference, the Sum multiplied by the Length gives the Solidity.

Example. *Let it be required to find the Solid Content of a Square Pyramid, the Side of whoſe greater Baſe is* 20 *Inches, the Side of the leſſer* 15 *Inches, and the perpendicular Height* 12 *Inches?*

Side greater Baſe 20
Leſſer Ditto —— 15

Product ——— 300
Sum of Squares 625

Sum ———— 925
One Third Height 4

3700

From the above Operation, the Solid Content is 3700 Inches, or 2 Feet 244 Inches.

Problem 10. *To find the Solid Content of Timber, according to the cuſtomary Method, bounded by ſeveral Curve and Plane Superficies.*

The Tree is girt with a Chalk-line, or Piece of Packthread, near the Middle, one Quarter of which they take for Square; this being multiplied by itſelf, and that Product by the Length, gives the Content of the whole Tree.

Example. *Admit a Tree* 12 *Feet in Girt, and* 30 *Feet long, what is its Solid Content?*

3 A Quarter of the Girt.
×3
9 its Square.
30 Length.
270 Content.

Hence the Content is 270 Feet.

From the very Nature of this Method, it appears that the Content above is much leſs than the real Quantity of Timber contained in the Piece, the Side being little more than that of the greateſt Square contained in the Piece; and conſequently when the Tree is reduced to a true Square, it will, according to this Method, contain nearly the ſame Quantity as before.

Others cauſe the Tree to be hewn ſomewhat in the Form of an irregular Priſm, conſiſting of four flat Sides, and four round; the latter of which are called Wanes; but in meaſuring this Piece, the flat Sides are ſuppoſed to meet and form a Square. They find the Area of the Baſe, which they multiply by the Length, and this laſt Product they ſuppoſe the Content of the Tree. But this Method is not leſs erroneous than the former; for this gives the Content a great deal too much, whereas the former made it too little.

The Government, in order to prevent Impoſitions, contracts that the Tree ſhall be hewed in ſuch a Manner, that what is called the Side of the

Square ſhall bear a certain Proportion to the Diameter of the Tree; which Proportion may be eaſily determined by the Callipers; for if we apply them to the Wanes, their Extent gives the Diameter of the Squares; if to the Flats, the Thickneſs, or Side of the Square. In order therefore to limit the proper Dimenſions of the Flats and Wanes, is is ordered that the Tree ſhould be hewed in ſuch a Manner, that two Wanes ſhall be equal to one Square. That is, that the Square A B, (*Plate* 2. *Fig.* 1.) ſhall be equal to the two Wanes. In ſome Contracts the Portion of the Chords produced beyond the Circumference of the Circle to complete the Square, are called Wanes.

Of Meaſuring PLANK and TIMBER.

Take the Length in Feet, the Breadth and the Depth in Inches.

No Meaſure leſs than half a Foot in Length is to be reckoned.

Neither leſs than one Inch in Breadth, nor leſs than half an Inch in Thickneſs.

In caſting up the Contents of ſeveral Pieces, nothing leſs than half a Foot in Superficial or Solid Meaſure is admitted.

Admit a Plank 17 Feet 9 Inches, by 21½ Inches.

	Ft.	Inch.	
Thus	17	9	
by	1	9½	
	17	9	
	14	0	
Content	31	9	The like of any other.

To Meaſure the ſame by the Sliding Rule; to 1 on A ſet 17¾ on B, then againſt 1¾ on A is 31¼ on B, the Content.

See *Meaſuring made eaſy, by the Sliding Rule*, or the *Mariner's Compaſs Rectified*, ſold by Meſſ. *Mount* and *Page*.

Of TIMBER MEASURE.

It is cuſtomary to take one-fourth of the Girt for the Side of the Square; which is generally taken in Inches and Quarters, and the Length in Feet and Halves. General Proportion by the Sliding Rule.

Set the Length on C to 12 on the Girt, Line, or D, then againſt the Quarter Girt on D is the Content on C.

A Piece of Timber 18 Feet long, by 15 Inches ſquare, what's the Content? ——— By Croſs Multiplication.

Thus 18 long.
× 1.3
18
4.6
22.6
× 1.3
22.6
5.7.6
Content 28.1.6 or 28,1 Feet.

A Piece of Timber 45½ Feet long, by 11¼ Inches ſquare. Now 45,5 × 11¼ × 11¼=5758,594, which divided by 144 gives 39,99, or 40 Feet.

Unequal-ſided Timber.

In a Piece of Timber 55½ Feet long, 16 Inches broad, and 9½ thick; how many ſolid Feet?

Arithmetically 16 × 9½=152 the Area of the End.
× 55½
760
760
76
144)8436(58,58 Feet.

Note. In meaſuring Trees that have their Bark on, it is cuſtomary to make the following Allowances, *viz.* For old Oak and Aſh Trees take 4 Inches from the Girt, and then take one fourth of the Remainder for the Side of the Square.

For Trees of a middle Age, take 3 Inches, and for young Trees take 2 Inches. The ſame Allowance in meaſuring Beech and Elm.

Admit an Oak Tree ſtript of its Bark to be 48 Feet long, the Girt at the greater End 128 Inches, in the middle 80, and at the leſſer End 32 Inches; what is its Content?

The Content by the common Method is but little more than 133 Feet, but by the Rule to Problem the 8, it is 191 Feet, as follows. The Diameter at the greater End is 41 Inches nearly, and at the leſs End 10 Inches, and Length 48 Feet. Then the Sum of the Diameters will be 51, which ſquared is 2601, from which ſubtract the Product of the Diameters 410; the Remainder is 2191; this multiplied by the Length in Feet 48; the Product is 105168, which multiplied by ,2618, gives 27532,9824, which becauſe it was multiplied by the Length in Feet, muſt be divided 144; gives the Content 191 Feet, or 58 Feet more than by the common Way.

N. B. That by this Method the Buyer gets a conſiderable Quantity, which will compenſate for the Sap, or frothy Part of the Tree.

Here follows ſome neceſſary Remarks.

1. Suppoſe the Tree cut into two, into its Middle, then the Girt of the greater Part in the Middle will be 104, its $\frac{1}{4}$ 26; and the leſſer 56, its $\frac{1}{4}$ is 14.

Now 26 × 26 × 24 ÷ed by 144 = $112\frac{2}{3}$ Feet.
And 14 × 14 × 24 ÷ed by ditto = $32\frac{2}{3}$ ditto.

Contents of both the Parts - - $145\frac{1}{3}$
Ditto of the whole as above - - $133\frac{1}{3}$ before it was cut.

By this Method it meaſures more by 12 Feet, when cut into Pieces of equal Length.

2. Suppoſe each Piece cut in the Middle, and the four Pieces of 12 Feet long each, to be meaſured about their Middles, and contented by the common Method, whereby the Content will be increaſed 15 Feet, *viz.*

The Girt of its greateſt Piece	116, its $\frac{1}{4}$ is	29	The Side of the Square in Inches of each.
of next ditto -	92, - -	23	
of next ditto -	68, - -	17	
of leaſt ditto -	44, - -	11	

And 29 × 29 × 12 ÷ ed by 144 is - 70,083
23 × 23 × 12 ditto - - - - 44,083
17 × 17 × 12 ditto - - - - 24,083
11 × 11 × 12 ditto - - - - 10,083

Total - 148,333 Feet.
The whole Content as before ——— 133,3

Increaſe of its Content by this Method —— 15 Feet

Hence appears the Falſity of this Method of computing the Contents by a ¼ of the Girt, taken in the Middle, for the Side of the Square of Geometrical mean Area, between the Areas of the Ends.

3. A Piece of Timber 40 Feet long, 12 Inches broad, and 6 Inches thick, contains 20 ſolid Feet. Let this be computed by the Girt Meaſure. ¼ Girt is 9 Inches, and 9 × 9 × 40, and divided by 144 gives 22½ Feet. Hence it appears, that unequal ſided Timber, computed by Girt Meaſure, produces more than its true Content; and in the above is 2½ Feet more in 20 Feet.

4. It alſo appears, that the Content of the Fruſtrum of any ſquare Pyramid, computed by taking ¼ of the Girt in the Middle; for the Side of the Square produces leſs than the true Content.

CHAP IV.

Of the Strength *and* Value *of* TIMBER, *&c. uſed by* SHIPWRIGHTS.

FROM numberleſs Experiments it is well known, that ſquare Pieces of like good Timber, equal in Bigneſs, but unequal in Length, being ſupported at each End, and Weights ſuſpended on the Middle, will bear in an inverſe Proportion to their Length: That is, ſuch a Piece of any Length will bear half the Weight that one of half that Length will bear. And two Pieces equal, and alike evenly joined to one another, will not only bear twice, but four Times the Weight that one will. In like Manner, any Number of ſuch Pieces, being laid one upon another, will bear Weights in Proportion to the Squares of thoſe Numbers: But if two or more ſuch Pieces be laid parallel to each other, or Side by Side, the Weights they will then bear, will be in an Arithmetical Proportion to their Number. From hence the Proportion of Strength in different Pieces of Timber may be eaſily computed: And in order to this, we ſhall add the Strength of ſome Sorts of Timber, as collected from Experiments.

A Piece of Wood of a Foot long, and an Inch ſquare, ſupported horizontally at both Ends, will bear in the Middle before it breaks, as follows:

	lbs.
Oak	320
Elm	310
Beech	290
Firr	280

It has been often obſerved to be highly neceſſary to preſerve Timber as whole as poſſible, and that it ought not to be converted till the Uſe it is deſigned for be actually known: Which Caution is generally regarded by ſkilful Workmen, it being a great Diſadvantage to reduce Timber to ſmaller Scantlings than it will bear. For if a Piece of long Timber be unadviſedly cut in the Middle, (not to mention the Weakneſs of a Ship compoſed of ſhort and narrow Pieces of Plank and Timber) the Opportunity is loſt of converting it to the moſt proper Service, as to what it would make length-ways, which is as 4 to 1: each Half, before the cutting, being alike ſerviceable one to the other, and having not only the ſingle, but joint Properties of each other. However, the Pieces will not be as 4 to 1 leſs in value than they were, becauſe they ſtill contain the ſame Quantity. But if you imagine a Piece of Timber, whoſe Sides are ſquare, and of a certain Length, and another in all reſpects like the former, only twice its Length, the larger Piece will contain twice the Quantity of the ſmaller, and be 8 times the Value, being every way throughout of double Scantlings, by which may be adapted to various Uſes, and prevent the Charge of unneceſſary piecing and ſcarphing. Now ſuppoſe the ſhorter Piece to be worth Ten Shillings, the longer will contain twice the Quantity and would be worth Twenty Shillings, if cut in the middle; but being whole, the Value is as 4 to 1, for ſervice; conſequently worth Eighty Shillings, or 8 times more than the ſhorter. Again, ſuppoſe the ſhorter Piece to be doubled in thickneſs, then it will contain 4 times the Quantity, and conſequently be of 16 times the Value; beſides a further conſideration in proportion to its Strength, according to what was ſaid in the beginning of this Chapter: What is here ſaid chiefly concerns large Timber, when its uſe and ſcarcity are alſo taken into Conſideration, but for one Piece of Timber, to be 16 times the intrinſic Value of another, it muſt be double its Dimenſions every way, that is, in Length, Breadth and Thickneſs, and conſequently contain 8 times the Quantity.

I ſhall therefore from theſe Principles lay down a Rule, which probably may adjuſt, or give at leaſt a Proportion of the Value of large Timber compared with ſmall. Though the Scarcity of the Commodity, and extreme want of it, with ſeveral other intervening Circumſtances may alter the Caſe very much; however theſe Conſiderations do not alter the intrinſic Value of the Materials, compared with each other, provided there be a general Uſe of all ſorts of ſound Timber proportionably to the Bulk it bears. And where the Caſe is not ſo, double Care ought to be taken to provide only ſuch as is uſeful.

Wherefore finding by Experience the uſual Prices of Timber at ſome Places to be near the Rules hereafter mentioned, I ſhall reduce both to a general Scale, which being known, Perſons will not hereafter be ſo liable to be impoſed on, and notwithſtanding theſe Commodities riſe and fall, the intrinſic Value or Proportion may be ſtill kept, and the Prices raiſed or abated ſo much *per Cent*.

If what has been already, or hereafter may be ſaid, comes up to a Demonſtration, yet it will be near enough for Practice. However I ſhall only offer it as an Eſtimate, and proceed; the Deſign being rather to give a Proportion of the Value, than an Account of the current Price, which always will be various.

Taking it then for granted, that like oblong Pieces of Timber (being as 1 to 8 in Quantity, or double to each other in Length, Breadth, and Thickneſs are in Value as 1 to 16; it will be found, by comparing the Properties of divers ſuch Pieces together, that the Value of like ſimilar Pieces are in Proportion to the Solidity of their Quantities; and that an equal Quantity (either *per* Foot, or *per* Load) of ſuch ſimilar Forms, are valuable in Proportion to the Extent of their Homologus Dimenſions.

Again, if you imagine a Piece of Timber, in form of a Parallepiped, and another double to it, either in Length or Breadth, by either of the Ways the new Piece will be augmented in Value as well as Quantity: Let either of the latter Pieces be called a double Piece, and either of them be again doubled, the long Piece in Breadth, or the ſhort one in Thickneſs, they will alſo be like augmented in Quantity and Value: Let either of them be called a Quadruple Piece, and ſuppoſe it again doubled, the ſhort one in Length, or the long one in Thickneſs, making either Way an Octuple Piece, ſimiiar to the firſt or ſingle Piece, as was before-mentioned, and of 16 Times the Value: Let thoſe 4 Pieces, *viz.* Single, Double, Quadruple, Octuple, be diſtinguiſhed according to their reſpective Orders, by A, B, C, and D, then as A : B, : : B : C, and B : C : : C : D. Alſo A : B : : C : D, as to Quantity; and the intrinſic Values, as Stores for Uſe, will be as the $\frac{4}{3}$ Powers of their Quantities; that is, the Biquadrate of the Cube Root of their Quantities, or the Cube Root of the Biquadrate of their Quantities: Thus,

1 : 2 : : 4 : 8 *per* Quantity.
A : B : : C : D
1 : 2,52 : : 6,32 : 16 nearly *per* Value.

The Biquadrate of 2 is 16; the Cube Root of 16 is 2,5198, or 2,52 nearly, which is the intrinſic Value of any Piece of Timber, that contains twice the Quantity of another, according to the Value of the ſmaller Piece, both Pieces being homogeneous and ſimilar. Suppoſe a Piece of Oak worth £ 1, then another Piece of the like Kind, containing twice the Quantity, will be worth 2,52 Pounds, or £ 2 10s. 2d. and a Piece 4 Times as large worth £ 6 6s. 5d. and univerſally the comparative Value of Timber will be as the $\frac{4}{3}$ Power of the Quantity.

And by tracing this Method throughout, it will be found, that not only ſimilar Pieces, but alſo all other regular oblong Forms of like good Timber, are in Value proportionable to the $\frac{4}{3}$ Power of their Quantities; or that a Load of one ſhall be in like Proportion to a Part of the other, provided all Timber, of what Shape ſoever, be alike uſeful according to the Bulk it bears, and alike eaſy to be procured. And this Rule I make no doubt will hold without Exception in rough Timber, making a Difference only in Compaſs Timber, Knees, *&c.* which for their Scarcity and Uſefulneſs are of much more Value than ſtrait.

But in converted Timber ſome ſmall Difference will happen, eſpecially when the Contents differ much, through the Charge of many Converſions, the Waſte which carries more or leſs in cutting, either of ſquare Timber or Plank, and the Value of the Piece out of which the ſame is cut, *&c.* as in Oak Board, where the Timber is required to be quartered; and in Treenels, where great Part of the Piece is waſted for the ſake of But, *&c.* all which ought to be duly conſidered before any Eſtimate can be ſet thereon. To which may be added the Hazard the Vender runs, and the Advantage the Buyer hath in ſeeing the Inſide, and diſcovering the Defects, which before lay hid from the moſt curious Search.

Upon the Whole then, I ſhall offer this as a general Rule, that like ſimilar and uſeful Pieces of Timber are valuable in Proportion to the $\frac{4}{3}$

Power of their Quantities; or an equal Quantity of each is reciprocall proportionable to the Content of their homologous Dimenſions as abov

Compare ſtrait Oak with ſtrait, Compaſs with Compaſs, Knees wi Knees, Elm with Elm, converted Timber as Beams, Foot-hooks, Thick ſtuffs, Planks, &c. to like Pieces and Forms. And hence are reduced th following Tables.

Elm in ſome Places is, according to its Quantity near as valuable ſtrait Oak, or within 5 *per Cent.* but Beach for its Uſefulneſs and Plent is not ſo valuable by above 12 *per Cent.*

It is farther obſervable, that the Method of buying a Quantity Timber, is to add the Contents together of the ſeveral Pieces; the Su thereof is called the *Meeting* of that Timber, and according thereto th Value of the whole Quantity is ſold. Which Method, though perhap near enough for Practice, is not really true. For whoever adds the re ſpective Value of each Piece by itſelf, will find the Sum total conſiderab to exceed what it would by adjuſting the Price by the aforeſaid proportio

Neither do I perceive any general Rule to be given in ſo various a Ma ter, when every different Content alters the Caſe, except to add the Val of every individual Piece; which being ſo intricate and troubleſome, ſhall only obſerve that this Difference ariſes from the Diſproportion b tween the Contents of the large and ſmall Timber; and the more th differ in Quantity, the greater will be the Alteration; the Value of t large being much diminiſhed, by being meeted with the ſmall.

From which it may be obſerved, that it is the Vender's Advantage ſell his Timber in as many Parcels as he can; and alſo whenſoever a Eſtimate is to be put upon one ſingle Piece, or upon a Quantity who Contents is nearly equal, an Abatement ought to be made of about 5 p *Cent.* in order to make the ſame agree with the following Tables, which a deſired for a Quantity, according to the common Cuſtom of Meeting.

An Eſtimate of the Value of Oak Timber, as it is ſuppoſe to be worth in divers Places, ſerved to the Place of Buſineſs free of all Charge to the Manager.

STRAIT.				COMPASS.				Rate per Load.
Meeting one with another.	No Piece under			Meeting one with another.	No Piece under			
	Cont.	Length	T. end		Cont	Length	T. end	
Feet.	Feet.	Feet	Feet.	Feet.	Feet	Feet.	Feet	l. s. d.
246	—	—	—	192	—	—	—	3—17—11
235	—	—	—	188	—	—	—	3—17—
230	—	—	—	184	—	—	—	3—16—9
235	—	—	—	180	—	—	—	3—16—2
220	—	—	—	176	—	—	—	3—15—7
215	56	26	13	172	37	17	12	3—15 0
210	—	—	—	168	—	—	—	3—14—4
205	—	—	—	164	—	—	—	3—13—8
200	—	—	—	160	—	—	—	3—13—0
195	—	—	—	156	—	—	—	3—12—4
190	—	—	—	152	—	—	—	3—11—8
185	—	—	—	148	—	—	—	3—11—0
180	48	24	12	144	32	16	11	3—10 4
175	—	—	—	140	—	—	—	3— 9—8
170	—	—	—	136	—	—	—	3— 9—0
165	—	—	—	132	—	—	—	3— 8—4
160	—	—	—	128	—	—	—	3— 7—8
155	—	—	—	124	—	—	—	3— 7—0
150	—	—	—	120	—	—	—	3— 6—3
145	40	22	11	116	27	15	10	3— 5—6
140	—	—	—	112	—	—	—	3— 4—9
135	—	—	—	108	—	—	—	3— 4—0
130	—	—	—	104	—	—	—	3— 3—3
125	—	—	—	100	—	—	—	3— 2—6
120	—	—	—	96	—	—	—	3— 1—8
115	—	—	—	92	—	—	—	3— 0-10
110	32	20	10	88	22	14	9	2—19-11
105	—	—	—	84	—	—	—	2—19—0
100	—	—	—	80	—	—	—	2—18—1
95	—	—	—	76	—	—	—	2—17—1
90	—	—	—	72	—	—	—	2—16—1
85	—	—	—	68	—	—	—	2—15—0
80	—	—	—	64	—	—	—	2—13-10
75	24	18	9	60	17	13	8	2—12—7
70	—	—	—	56	—	—	—	2—11—4
65	—	—	—	52	—	—	—	2—10—1
60	—	—	—	48	—	—	—	2— 8-11
55	—	—	—	44	—	—	—	2— 7—6
50	—	—	—	40	—	—	—	2— 6—0
45	—	—	—	36	—	—	—	2— 4-4
40	16	16	8	32	12	12	7	2— 2—8
35	—	—	—	28	—	—	—	2— 0-11
30	—	—	—	24	—	—	—	1—19—0
25	—	—	—	20	—	—	—	1—16—7
20	—	—	—	16	—	—	—	1—13—9
15	—	—	—	12	—	—	—	1—10—8

An Eſtimate of the Value of Knees, none being under the following Content; ⅓ being Raking and ⅔ Square.

Contents.	Meeting	Rate *per* Load.		
Feet	Feet	l.	s.	d.
8	36	5	10	0
7		5	6	0
6	27	5	0	0
5		4	14	0
4		4	7	0
3	18	4	0	0

An Eſtimate for the Valuing of Beams converted, &c.

Length	Square	Rate *per* Load.			Value of each.		
Feet	Inches	l.	s.	d.	l.	s.	d
44	18	9	10	0	18	10	0
43		9	7	6	17	16	6
42		9	5	0	17	5	0
41	17	8	18	0	14	12	0
40		8	17	0	14	1	0
39		8	15	6	13	10	0
38	16	8	8	0	11	5	0
37		8	6	6	10	16	6
36		8	5	0	10	9	0
35	15	7	16	0	8	10	0
34		7	14	0	8	3	0
33		7	12	0	7	16	0
32	14	7	5	0	6	7	0
31		7	2	6	5	18	6
30		7	0	0	5	12	0
29	13	6	13	0	4	10	0
21		6	11	6	4	6	0
27		6	10	0	4	2	6

An Eſtimate of the Value of Oak Plank.

Thickneſs.	Meeting in Length.	None under		Rate *per* Load.
		Length	Breadth top end	
Inches.	Feet.	Feet.	Inches	l. s. d.
4	32	23	12	6—11—0
	31			6—9—0
	30			6—7—6
	29			6—6—0
	28			6—5—0
3	27	20	11	5—11—0
	26			5—9—6
	25			5—8—0
2	24	17	10	4—13—0
	23			4—12—0
	22			4—11—0
1½	21	14	9	4—2—0
	20			4—0—6
	19			3—19—0

An Eſtimate of the Value of Oak Treenels.

Length	Diameter	Charge of making.	Value of the Neceſſary Wood.	Rate *per* Thouſand
Inches	Inches.	s. d.	l. s. d.	l. s. d.
36	2—0	30—0	10—10—0	12—0—0
30	1—8	21—9	6—3—3	7—5—0
24	1—6	15—0	3—10—0	4—5—0
18	1—4	9—9	1—12—9	2—2—6
12	1—2	6—0	0—14—0	1—0—0

The irregular Form of Ships renders the procuring Timber for building them both difficult and expenſive: For if Ships were regularly formed by ſome Geometrical Curve or Figure, Timber, and all other Utenſils might be as well provided for them as for building any other Fabrick. Timber might be converted to its various Uſes in the Woods, and conſequently Carriage paid for only what is really uſeful; and as both the Safety and Commerce of this Nation greatly depend on the Strength and Number of our Shipping, the Care of our Foreſts well deſerves our ſerious Attention, as it muſt be very diſadvantageous to be obliged to have recourſe to our Neighbours, and purchaſe at a very conſiderable, and continually renewed Expence, what might, by an eaſy Œconomy, be ſufficiently ſupplied at Home.

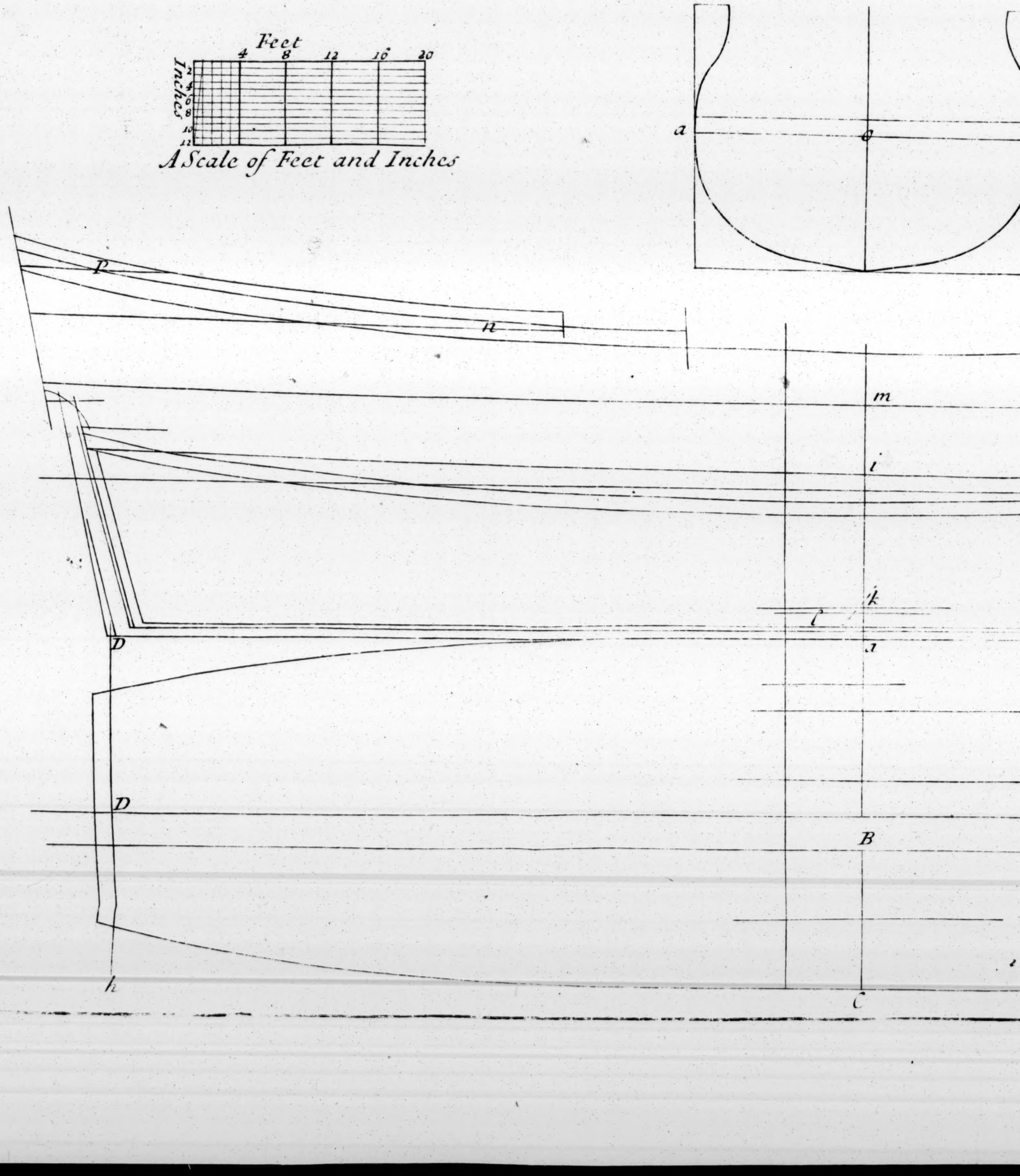
It would therefore, in order to the preſerving our growing Timber Trees, be a very uſeful Law, that all who cut down any Number of Oaks, ſhould alſo leave a certain Number in good Condition for After-cutting; and that no Timber ſhould be cut down but at a proper Age, in regard to the Nature of the Soil; ſince it is certain that Trees grow to their Perfection at very different Periods of Time, in Proportion to the Depth of the Soil, and that as it is not for the Intereſt of the State to ſuffer Trees to be cut, till at their Perfection for Size and Soundneſs, ſo after they are arrived at that Perfection, it is equally certain that they gradually decay.

The Quality of the Soil may be neceſſary to be obſerved for this Purpoſe; but the Quantity or Depth of it is the great Subject of Enquiry; and a great number of Obſervations have proved, that the proper Seaſon for cutting Oaks, in a Soil of two Feet and a half deep, is at Fifty Years old; thoſe which ſtand in a Soil of three Feet and a half deep, ſhould not be cut before Seventy Years; and thoſe which ſtand in a Soil of four Feet and a half deep, or more, will increaſe in Goodneſs, and in Soil, till they are an Hundred Years old: And Obſervations have proved, that, after theſe ſeveral Periods, the Trees begin to decay.

This ſeems the beſt Rule to eſtabliſh in regard to common Soil; but thoſe which grow in a lighter or more ſandy Soil, may have their Periods changed from thoſe above to Forty, Sixty, and Eighty Years, at the greateſt Depth. It is always beſt to fell the Wood intended for Publick Service, whether then wanted or not; ſince it is much better to keep it in Magazines, than to ſuffer it to ſtand, and daily decay.

Heaths, and other uncultivated Places, generally afford ſome ſtraggling Trees of Oak. Theſe ſeldom grow tall or regular, ſince their not having been defended from the Injuries of Cattle, they are uſually browſed on

D.g. The Length of the Keel from the Back of the main poſt $\frac{3}{5}$ of the
a.c. Is the Breadth from the Outſide of one plank to the outſide of the
a.o. Half that Breadth 16 ft
g.f. Is $\frac{3}{5}$ of a.c. or is a.B. 20 feet $\frac{4}{10}$.
But in taking the Length I have seen that in full Ships
Extream fore part of the Stem as h.g. and set back $\frac{3}{5}$ of th

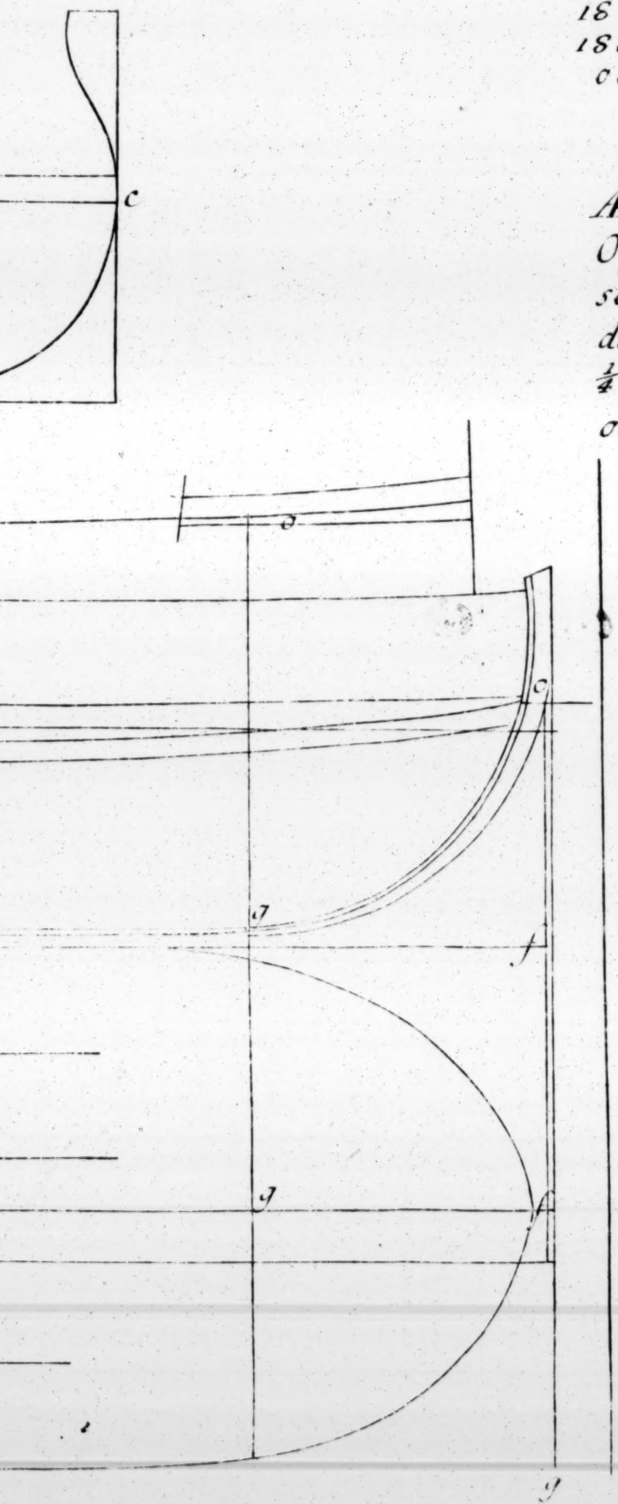

A Scale of Feet and Inches

the main breadth ſhort of the up̄er edge of the Lower Harping . . 94 ft. 0 In.
of the Other 32

188
282
3008
16
18048
3008
48128

hips they have taken it to the
of the Breadth from thence .

Tuns
94 (48128) 512
470
112
94
188
188
00



As to the Rake of the Stern Poſt, it was the Opinion and Cuſtome of Old M^{r} Shiſh and his sons, all Eminent Builders, for every perpendicular hight of the Stern poſt,^{to} set off 2 Inches & ¼ aftward, which will make A Comely Rake or Rombus .

i.k. Is the Depth in hold at the
Side to which muſt Be added
the Round of the Beam
i. The Gun deck line at the side or
up̄er part of the Beam
m. The uper Deck D^{o}.
n. The Quarter Deck
o. The forecaſtle Deck
P. The Poop Deck
k The up̄er part of the Limber board
l The cut^{t}ing Down or up̄er part
of the floor-timber.

and t
made
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Of

W
Theſe
muſt
Timb
being
that c

and ſtunted while young, and ſo become crooked, or ſhort-trunked, or are made Pollards. Theſe are, however, of great Value to Shipwrights, being naturally bent, and formed for many Uſes in Marine Architecture.

The little Care uſually taken of theſe Trees, though in this reſpect of the greateſt Value, ſeems to threaten a general Loſs of them; but as Trees thus crooked and bent, are of great Value in Ship-building, it is an uſeful Attempt to endeavour to diſcover a regular Method of producing ſuch; and this is eaſily practicable, by following the ſame Method by which theſe wild ones became ſo. They wholly owe their Figure to the Cattle's biting off their Tops while young, and afterwards biting off the Tops of the Tops of the Shoots from the firſt Wound. In this Manner, if a Number of young Trees, ſet apart for the Experiment, have their Tops cut off at two, four, ſix, eight, ten, and twelve Feet from the Ground; and four Years afterwards, the Shoots of theſe ſtunted Tops again cut in the ſame Manner, the Trees will be found afterwards to grow up in all the irregular crooked Figures that can be conceived; and by this Means a Supply of naturally crooked Timber may be raiſed for the Occaſions of Ship-building, with Eaſe and Certainty.

The Defects of Timber are various; but they are in general owing to the Nature of the Soil In looſe and broken ground the Timber is uſually ſhaken, which is a common Defect, and very pernicious. A ſtrong Clay commonly produces good Timber.

Timber from 4 Inches to 1 Inch and a half is called Plank, and uſed for covering the Timbers, and being well caulked, keeps the Cavity dry. This is generally converted to its intended Thickneſs in the Woods.

CHAP. V.

Of delineating the FORMS *or* MODELS *of the Timbers of* SHIPS.

WHEN a Ship or Veſſel is propoſed to be built, the firſt Thing mentioned is her Dimenſions, as Length, Breadth, Depth, *&c.* Theſe being determined, the Timbers which from the Sides of the Ship muſt be conſidered. A Frame of Timbers is compoſed of one Floor Timber, two or three Futtock, and on each Side a Top Timber. Theſe being united, and properly ſecured, form a circular Incloſure, of which that circumſcribing the greateſt Area is termed the Midſhip Frame. The

Curve of this Frame at the lower Parts is inverted, whence the Floor Timber, in the Middle, will be ſomewhat hollow, and, conſequently, the Ends form a very Obtuſe Angle; but this Angle decreaſes in ſuch Proportion to the Diſtance of the Frame from the Midſhip, that the foremoſt and after-moſt may become very ſharp, and form a very acute Angle.

Shipwrights are generally agreed with regard to the Length of the Midſhip Floor Timber, making it generally Half the Length of the Main Beam; but with regard to the Riſing of it, they differ extremely; ſome chuſing a ſharp, and others a flat Floor. Each has its Advantages and Diſadvantages; for the more Riſing a Ship has, ſhe will ſail the better when cloſe cloſe upon a Wind; but then ſhe will draw the more Water. On the contrary, the flatter a Ship is, the leſs Water ſhe will draw, but then ſhe will not ſail ſo well when cloſe upon a Wind.

Nor are the Shipwrights better agreed in determining the Station of the Midſhip Frame, ſome placing it before, others at the Middle of the Ship; others again have two Floor Timbers of equal Length and Riſing, one of which they place exactly in the Middle, or the Breadth of the Timber nearer the Head, and the other a proper Diſtance before it.

Thoſe who place it before the Middle of the Ship alledge that a Ship which is full Forward, after ſhe has once divided a Column of Water, ſhe will meet with no farther Reſiſtance, and the Fluid will eaſily unite abaft, and by that Means increaſe the Ship's Velocity, and have more Power on the Rudder, the farther it is from the Center of Gravity. They alſo add that a Ship built in this Manner comes the neareſt to the Forms of Fiſhes, which ſeems the moſt Advantageous for dividing Fluids: And this agrees with Experiments.

The Riſing of this Midſhip Floor Timber being determined; the next thing is to fix the Height of the Riſing-line of the Floor, both abaft on the Stern-Poſt, and forwards upon the Stem.

As all Ships are narrower both Abaft and Forward than in Midſhips, the other Floor Timbers will conſequently be ſhorter, and have a greater Riſing, which will continually increaſe till they terminate on the Poſt and Stem. Builders uſe different Methods in fixing the Height of this Line. Some are of Opinion, that by narrowing the Floor abaft, which will cauſe the Riſing-line on the Poſt to be high, the Ship will not only ſteer the better, but the Water being opened by the Midſhip Frame, will cauſe a greater Preſſure on the after Port of the Ship, and thereby increaſe he Velocity. But this Opinion does not ſeem to be well founded. Indeed if the Steerage were the only Thing to be conſidered, it muſt be granted, that the higher the Riſing-line is carried abaft, and the narrower a Ship is, the Water will have the freer Paſſage to the Rudder, and have the more Power upon it. But it muſt be remembered that by this Means we take away the Buttock, which is the only Thing we have to ſupport all the Weight of the after Part of the Ship; neither ſhall we be able to give a proper Balance between the fore and after Parts; and when theſe are not duly balanced, it will cauſe the Ship to pitch very much, and be in danger of being pooped by the Sea, when it runs high. And therefore to prevent theſe Inconveniences it will be proper to give all Ships, eſpecially thoſe which are large, a full Buttock.

The Dimenſions being agreed upon, a Draught is prepared proportionable to theſe Meaſures; but as a Plane has but two Dimenſions, *viz.* Length and Breadth, and a Solid three, they cannot all be repreſented on the ſame Plane by one ſingle Projection. Shipwrights generally make Uſe of three Planes to repreſent the Dimenſions of one Ship, which they call the Sheer Plane, the Floor Plane, and the Body.

The Sheer Plane is the ſame which Architects call the Elevation, being the Section of a Ship, ſuppoſed to be cut by a Plane paſſing through the Middle Line of the Keel, Stem, and Stern-Poſt. This Plane is repreſented on *Plate* 1 *Fig.* A

On this Plane the Heights of the Breadth-Lines are deſcribed in order to determine the Heights, at which the Half Breadth-Lines are to be ſet off. Theſe Lines, becauſes the extreme Breadth of each Timber riſes gradually from the Midſhips fore and aft, will be Curves.

The Floor Plane, is that which other Artiſts call the Horizontal, or Plan of Building, being that on which the whole Structure is erected. This Plane is repreſented, *Plate* 1 *Fig.* B.

On this Plane are deſcribed the Half Breadth-Lines, which are Curves limiting the Half Breadths of the Planes of the Timbers, at the Heights expreſſed by the correſponding Height of Breadth on the Sheer Plane. Theſe Curves are formed by ſuppoſing the Ship to be cut lengthways by a Plane perpendicular to the Sheer Plane, or parallel to the Floor Plane through a Curve Height of Breadth Line.

The Body is the ſame which others call a Profile: It is a Section ſuppoſed to be cut by a Plane, perpendicular to both the Sheer and Floor Planes, through the broadeſt Part of the Boat or Ship. This ſection is repreſented, *Plate* 1, *Fig.* D.

The Draft or Model is uſually deſcribed upon large Paper, and the Scale uſed in delineating it, is generally as 1 to 48, that is, the Diſtance between each large Diviſion is $\frac{1}{4}$ of an Inch, conſequently each $\frac{1}{4}$ of an Inch on the Paper is a Foot on the Platform.

Sundry Particulars to be obſerved.

1. Water-Lines are ſuppoſed to be drawn on the Surface of the Ship by the Surface of the Water in which ſhe ſwims, and there formed by the Section of the Floor Plane cutting the whole Body length-ways, parallel to the Floor Plane; they will be repreſented by ſtrait Lines on the Body Plane, called Level Lines, which are generally marked, 1ſt, 2d, 3d, W. r.

2. The Heights of the Breadth Lines are deſcribed on the Sheer Plane, to determine the Heights at which the Half Breadths of the Planes of the Timbers are to be ſet off.

3. Half Breadth Lines are deſcribed on the Floor Plane, and are Curves limiting the Half Breadth of the Planes of Timbers, at the Heights expreſſed, by the correſponding Height of Breadth on the Sheer Plane.

4. *Ribband Lines are either Square or Canted.*

The Square, which is often called the Horizonal Ribband Line, is in all reſpects the ſame with the above deſcribed Half Breadth Lines; the Uſe of the Ribband is to faſten the Timbers before the Plank is brought on; for which Purpoſe they muſt be of a ſufficient Subſtance, and formed in ſuch a Manner, that they may fit the Timbers without forcing or penning them. It would be very difficult to make a Square one, becauſe it rounds two ways; for when the Ship is cut upon a Level by this Ribband, the Surface produced will be an uneven one, upon this Account, a Plane muſt be ſo inclined to the Sheer Plane, that it ſhall interſex the Timbers at the ſame Points with the Square Ribband.

5. The Cant, or Diagonal Ribband, ſo called becauſe it cuts the Body Plane obliquely, in a diagonal Manner by a Plane inclined to the Sheer Plane, and cutting the Ship Length-ways in that Direction, in ſuch a Manner, that it will interſect the Timbers in the ſame Point that the Square Ribband does.

6. Sweeps, are Arches of Circles deſcribed in the Body Plane to form the Timbers, and are generally four.

1. The Floor-Sweep, which is limited by a Line drawn in the Body Plane, perpendicular to the Middle Line, a little above the Keel, the Diſtance of this Line above the Keel, at the Midſhip Timber, is called the Dead Riſing; the upper Part of this Arch forms the Head of the Floor Timber.

7. The under Breadth Sweep, the Center of which is in the Line that repreſents the Height of the extreme Breadth of the Timber. If there is

a Part of the Timber ſtrait, the Center of the Sweep will be in the lower Line.

From this Center extend to the Point that limits the Half Breadths of the Timber in the ſame Line, and with that Radius deſcribe a Circle downwards, till it comes near the Floor-Sweep.

8. The Reconciling Sweep, which joins the two former, in ſuch a Manner, as to interſect neither; by which Means we ſhall have a fair Curve from the Height of the Breadth to the riſing Line. And if a ſtrait Line be drawn from the Side of the Keel, at the upper Edge, to touch the Back of the Floor-Sweep, we ſhall have the Form of the Midſhip Timber below the Breadth.

9. The upper Breadth Sweep, the Center of which is in the Line that repreſents the extreme upper Height of the Breadth of the Timber; from which a Circle muſt be deſcribed to paſs through the Point that limits the Half Breadth of the Timber in the ſame Line, and produced upwards diſcretionally to form the top Timber. To theſe four ſome add a fifth, to form the hollow of the top Timber; but this is generally done by a mould, ſo placed as juſt to touch the above Breadth Sweep, and paſs thro' the Point that limits the Half Breadth of the top Timber; ſo that now the Form of the Midſhip Timber is determined from the Keel to the Top of the Side. The Radius of the underneath Sweep decreaſeth the farther the Timber is from the Midſhips; but the other Sweeps have generally the ſame Radius for all the Timbers. There is no certain Rule to determine the Radius of theſe Sweeps, ſome do it by proportioning them to the extreme Breadth of the Ship, according to ſome given Ratio. But there are various Ways of forming this Midſhip Timber; ſometimes by two Arches, and, inſtead of having a ſtrait Line from the Edge of the Keel to touch the Back of the Floor Sweep, in ſome Ships it is made a Hollow.

10. Half Breadth of the Floor is the Diſtance of the Center of the Floor Sweep, from the Middle Line in the Body Plane at the Midſhip Timber, which will always be leſs than the Diſtance between the Point, where the ſtrait Line is drawn from the Side of the Keel to touch the Back of the Floor Sweep. This laſt may be called the true half Breadth of the Floor, and in ſharp ſhips will be above the riſing Line.

11. Riſing of the Floor, is a Curve drawn on the Sheer-Plane, limited at the Midſhips by the Dead Riſing; and in flat Ships, it runs nearly parallel to the Keel for ſome Timbers before and abaft the Midſhips, for which Reaſon theſe Timbers are called Flats; but in ſharp Ships it riſes gradually from the Midſhip till it ends on the Stem and Poſt.

To this Line is ſometimes adapted a Half Breadth Line. The Uſe of thoſe two Lines is to find the Centers of the Floor Sweeps.

12. Cutting down Lines are drawn on the Sheer Plane. They are limited in the Midſhips by the Thickneſs of the Floor Timber, and abaft by the Breadth of the Kelſon; for which Purpoſe the Thickneſs of the Timbers muſt be known. They muſt be carried up ſo high upon the Stem, as to leave ſufficient Subſtance for the Breaches of the riſing Timbers. The lower Edge of the Kelſon is in this Line: So it limits the Thickneſs of all the Floor Timbers, and likewiſe the Height of the dead Wood afore and abaft.

13. Timber and Room, or Room and Space, is the Diſtance between the moulding Edges of two Timbers, which muſt always contain the Breadth of two Timbers, and ſometimes two or three Inches between them. It muſt be obſerved, that one Mould ſerves for two Timbers; the fore Side of the one being ſuppoſed to unite with the aft Side of the other, and ſo make only one Line, which is actually the Caſe in all the Frames, which in ſome ſhips are every third, and in others every fourth Timber.

14. The Frames are firſt put up, and faſtened to the Ribband; and afterwards the others are put up, which are called Filling Timbers. The Midſhip Timber is called Dead-flat, and diſtinguiſhed by this Character ⊕; the Timbers abaft the Midſhip are diſtinguiſhed by the Figures 1, 2, 3, &c. and thoſe before the Midſhip, by the Letters of the Alphabet, A, B, C, &c.

Of WHOLE MOULDING.

THE Length of the Keel, extreme Breadth, Depth of the Hold, Height between Decks, and in the Waſte; and ſometimes th Height and Breadth of the Wing-tranſom are agreed on by Contract i the Merchant's Service: From which Dimenſions the Builder is to for a Draught ſuitable to the Trade the Ship is deſigned for.

The firſt Thing that is generally done is to lay down the Keel, Stem and Poſt, upon the Sheer-Plane; then to determine the proper Station o the Midſhip Timber, where erect a Perpendicular: It is generally abou $\frac{2}{3}$ of the Keel before the Poſt. On this Line the given Depths of th Hold is ſet off from the upper Side of the Keel; to obtain which Poin the Thickneſs of the Timber and Plank muſt be added to that agreed o by Contract. This being fixed, will enable us to determine the upp

Height of the extreme Breadth at that Place, which ſometimes is the very Point itſelf The lower Height of the Breadth muſt likewiſe be determined at this Place. Then we may form the the two main Heights of the Breadths of the Lines, which nearly unite abaft and afore. Abaft, theſe Curves end at the Wing Tranſom, or above it; and afore, they are carried up ſometimes as high as the Hawſe Holes. The Height of the Breadth Lines of the top Timber muſt likewiſe be formed. This is generally done by a Bow, which makes nearly an Arch of a Circle. It is limited in Midſhips by Contract, before and abaft, only by the Judgment of the Artiſt, according to what Sheer he deſigns: We muſt alſo form a Line for the riſing of the Floor; for which Purpoſe we muſt determine the Dead Riſing, which is that of the Midſhip Timber. This limits it at that Place, and in the whole Moulding it is pretty near parallel to the lower Height of the Breadth Line. Theſe Lines muſt be drawn on the Sheer Plane, correſponding to the main and top Timber Height of Breadth Lines, there muſt be two Half Breadth Lines formed on the Floor Plane.

The main Half Breadth at the Midſhip Timber is agreed on by Contract, only by obſerving, that the Thickneſs of the Plank muſt be deducted out of it, becauſe it is the extreme Breadth from outſide to outſide of the Plank that is contracted for. Thoſe in the Draughts are called moulded Half Breadths: Then the Breadths, at the Wing Tranſom, if a Square Stern is limited, it is generally about two-thirds of the extreme Breadth; but this is juſt as the Artiſt ſhall think proper: He alſo fixes the Breadth of the top Timber, and then deſcribes the two Half Breadth Lines. In the due Formation of theſe Curves on the Sheer and Floor Planes, the whole Art of Drawing chiefly conſiſts; which muſt be acquired by Practice, o that it will be ſcarce poſſible for any one, that is not very well acquainted ith drawing, to form them, without having recourſe to ſome other Draughts. After theſe are formed, the Stations of the Timbers are fixed, the Room and Space, and the Breadth of the Midſhip Timber is agreed n by Contract, this will determine the Station of all the Timbers; ob- rving that the Timbers, abaft the Midſhip, muſt be ſet off from the fore ide of the Midſhip's Timber; and the Timbers before the Midſhip from e aft Side of it. At every third or fourth Timber, there muſt be Per- ndiculars drawn on the Sheer and Floor Planes to the Line that repreſents e lower edge of the Keel, which is the common Section of theſe two anes; though ſometimes the Half Breadth Lines are deſcribed on the eer Plane, when there is not Space to produce the Perpendiculars till y be of ſufficient Length to contain the Height of the Breadth and alf Breadth.

After the Timbers are ſtationed, and the Perpendiculars for the Frames drawn on the Sheer and Floor Planes; we proceed to the Body Plane, and having drawn a Line equal in Length to the whole Breadth moulded, which call the Baſe-line of the Body Plane; erect a Perpendicular at each end of it, and one in the Middle, which may be produced at Pleaſure. The next Thing to be done, is to form the Midſhip Frame: The Limits of it are had from the Sheer and Floor Planes; the lower, upper, and top Timber Heights of the Breadth are taken from the Sheer Plane at the Perpendicular, repreſenting the Midſhip Frame, and ſet off on the Middle Line of the Body Plane from the Baſe, through theſe Points, Lines are drawn parallel to the Baſe, and the reſpective Half Breadths correſponding to each, are ſet off on theſe Lines, from the Middle Line in the Body Plane, the lower and upper main Half Breadths are limited by the Perpendicular already drawn at each End of the Baſe, the Half Breadth of the top Timber is had from the Floor Plene on the Perpendiculars repreſenting the Midſhip Frame. The Height of the Dead Riſing is likewiſe taken from the Sheer Plane, and ſet up from the Baſe upon the Middle Line in the Body Plane, through which Point a Line parallel to the Baſe muſt be drawn; and upon this Line the Half Breadth of the Floor is ſet off from the Middle Line, at which Point a Perpendicular is erected.

The Center of the Floor Sweep is in this Line, from which a Circl muſt be deſcribed, that ſhall juſt touch the riſing Line. A proper Radius for the under Breadth Sweep is next to be found: The Center o it is in the lower Breadth Line, from which it is deſcribed to paſs through the Point, which limits the Half-breadth. After which the Radius, and Center of a reconciling Sweep to join the Floor, and under Breadth Sweeps is found, and the Circle deſcribed; and to compleat the Frame below the Breadth, the Half-breadth of the Keel is ſet off from the middle Line on the Baſe; from which Point, a ſtrait Line is drawn to touch the Back of the Floor Sweep.

By this Way of forming the Frame, it is plain the Centers and Radii of the Sweeps are arbitrary, but they muſt be determined before any o the other Sweeps can be formed; if by no other Means, by repeated Trials, till they are made to pleaſe the Fancy and Judgment of the Artiſt But there are various other Ways of forming this Frame; though ſevera Ships may be made of the ſame Breadth, Depth in the Hold, and dea riſing, they may all differ in the Form of their Timbers. After th Midſhip Timber is formed, a Pattern or Mould is made to fit exactly t the Curve, and the dead riſing Line, by this, and a hollow Mould, all th Timbers are formed as far as the riſing Line, and lower Height of th

Breadth Line, parallel to one another in the Sheer Plane: This is what is called whole Moulding, which we ſhall illuſtrate by laying down a Boat. And becauſe in ſeveral Mould Lofts there is not ſufficient Length for the Sheer Plane, it is often laid down, as if it were cut by the Midſhip Frame, and one Part laid upon the other, in ſuch a Manner, that the Midſhip Timber of the after Part, ſhall coincide with a Perpendicular let fall from the fore Part of the Stem.

A View of the Parts reſpecting the Sheer, Floor, and Body Planes; and the Order of drawing the Lines of each Plane. Firſt *of the Sheer Plane, Fig.* A. *Plate 1ſt.*

1. DRAW the ſtrait Line a b, to repreſent the lower Part of the Keel, in this Line aſſign the Place of (⊕) dead Flat, and ſet ff from the Scale ſome aliquot Part of the whole Length of the Keel; n this the Length of the Boat is 15 Feet, and 16 divided by 12 is 1 Foot Inches, the Part to be ſet off from ⊕ both Ways, to the two other Flats, arked ſomething like the dead Flat, from thence to A, to B, and C; alſo o 1, to 2, &c. and then erect the Perpendiculars upon thoſe Points, and t off the Thickneſs or Height of the Keel, and draw the Line g f, to preſent the upper Part of the Keel, and a Line a little below it to reeſent the Rabbet, or Thickneſs of the Plank in Ships.

2. From the upper Part of the Keel at ⊕ ſet off to h and i, the lower d upper Heights of Breadth, at that Place; alſo ſet off the Height of readth 5, o, and B, u, and draw the Curve lined Heights of Breadth o u n, and e i m, for the lower and upper Heighths of Breadth; then t off the Heights of the riſing Strait and riſing Line.

3. Set off the Rake of the Poſt from r to g, and draw r L, for the ter Side of the Poſt; then L l, will repreſent the round up of the ranſom. Set off the Breadth of the Poſt from e to k, and from q to l, d draw k q, and e l,; ſet off alſo the Height of the Tuck from r to e, d from e to k the Thickneſs of the Tranſom, and draw k S, and s L to preſent the Foreſide and Top of the Tranſom.

4. Set off the dead riſing, that is, the Height of the Floor at (⊕) to alſo B x, and 4 y, and draw the riſing Line, e y p x f. Let (⊕) A, C, repreſent the Names and Places of the Timbers in the Fore-body, d 1, 2, 3, 4, 5, thoſe of the After-body.

Second

Second, *Of the Floor Plane, Fig.* B.

To form the half-breadth Line, let the perpendicular Lines l g, o,5, h, ⊕, u B, &c. be continued downwards, and ſet off the Half-breadths, Cz. from the Flats to E, F, H; the half-breadths alſo at the Tranſom be and B, and at ſome intermediate Places, and then draw the half-readth Curve-line to repreſent the Outſide of the Timbers at the Harpin.

Third, *Of the Body Plane, Fig.* D.

Make a b equal to the Breadth moulded at ⊕. Erect the Perpendicular c d, and parallel thereto draw a f, b g, and ſet off the half thickneſs of the Poſt and Stem, to the Right and Left of c d; which being done, take off the Parts of the ſeveral Perpendiculars at the Flats, and A B alſo at 1, 2, 3, *&c.* intercepted between the upper Edge of the Keel, and the riſing Line in the Sheer-plane, which ſet off from c upon the Line c d; through theſe points draw Lines parallel to a c, and take off the ſeveral lower Heights of Breadth at ⊕, 1 2, *&c.* from the Sheer plane, and ſet them up from c, and draw Lines parallel to a c, as before; then take off the ſeveral Half-breadths correſponding to each from the Floor-plane, and ſet them off on their half-breadth Lines, from the Line c d.

In the next Place we are to form the Midſhip-Timber, either by Sweeps, or ſome other Method, according to the Judgment of the Artiſt; if three Sweeps are to be uſed, a Center of each muſt be found: And this Method of drawing by Sweeps is fully explained before. What has been ſaid may give the Reader ſome Idea of the Nature of the Principles of Naval Plans, and acquaint him with the Terms neceſſary to be known before he makes a Contract with a Builder, which is the chief Intent of this Chapter.

ARTICLES *generally agreed upon by* CONTRACT.

Firſt, The Ship to be of a certain Burthen, or Number of Tons.

Second, The Length of the Keel, extreme Breadth, and Depth in the Hold, or between the Floor and the Deck; the Height between Decks, the Breadth of the Wing Tranſom, and its Height, the Height of the Waſte, *&c.*

ARTICLES *reſpecting the* SHEER-PLANE.

1. The Midſhip-frame ſhould be at or about two Thirds or three Fifths of the Keel from the Poſt, and it is always marked with ⊕, called Dead-flat.

2. The extreme Breadth to be nearly one Third, or between one Third and one Fourth of the Length of the Keel.

3. The perpendicular Heights between the upper Side of the Keel, and the firſt and ſecond Heights of Breadth in the Midſhips.

4 The Height of the riſing Line, or Floor, is to be firſt ſet off at ⊕, and then the Curve is to be drawn nearly parallel to the Line of the lower Line Height of Breadth.

5. The Height of the lower Deck above the Floor.

6. The Height of the upper Deck, or Diſtance between Decks.

7. The Rake of the Poſt, and Rake of the Stem.

8. The Height of the Poſt and Stem.

9. The Depth of the Keel, and its Siding, or Breadth at Midſhips.

10. The Draught of Water abaft more than before.

Scantlings of the Principal Pieces of Timber in Merchant Ships.

Names of the Pieces.			Tons 80	Tons 110	Tons 220	Tons 330	Tons 440	Tons 600	In Ship War Tons 900
			Ft.In	Ft.In.	Ft.In.	Ft.In.	Ft.In.	Ft.In.	Ft.In.
Beams	Lower Deck	Sided or broad	0 9	0 11	0 11½	1 0	1 1	1 2	1 2¾
		Moulded or deep	0 8	0 10	0 10½	0 11	1 0	1 0½	1 2¼
	Upper Deck	Sided	—	0 8	0 9	0 10½	0 11	1 0	1 0½
		Moulded	—	0 6½	0 8½	0 9	0 10	0 11	0 10¼
	Quart. Deck	Sided (two-thirds of the Beams, & 1 in. more t'otherway)	—	—	—	—	—	0 8	0 8
		Moulded	—	—	—	—	—	0 6	0 6⅝
	Fore Caſtle	Sided	—	—	—	—	—	0 8	0 8½
		Moulded	—	—	—	—	—	0 6	0 6⅝
Breaſt Hooks ſided			—	0 8	0 9	0 10	0 11	0 11½	1 1
Carlings	Two thirds of the Beams, and 1 in. more t'other way		—	—	—	—	—	—	0 7
Clamps	Lower Deck		0 3	0 4	0 4	0 4½	0 5	0 6	0 6
	Upper Deck		—	0 3½	0 3½	0 3½	0 4	0 4	0 4
Keel	Sided at the Stem		0 9	0 11	0 11½	1 0	1 1	1 2	1 2
	Ditto in the Midſhips & Deep		0 9	0 11	0 11½	1 0	1 1	1 2	1 2½
	Ditto at the Poſt		0 8	0 11	0 11	0 11½	1 0	1 1	1 0½
	Falſe		—	0 2	0 2½	0 3	0 3	0 4	0 4
Keelſon	Deep		0 8	0 11	0 11½	1 0	1 1	1 2	1 2½
	Thwartſhip		0 8½	0 10	0 10½	0 11	0 11½	1 2	1 2
Knees	Lower Deck	Hanging ſided	—	0 7	0 7½	0 8	0 8½	0 9	0 8½
		Lodging 1 in. leſs	0 5	—	—	—	—	—	—
	Upper Deck hanging		—	0 5½	0 6	0 6½	0 7	0 7½	0 6
	Tranſom, 1 in. leſs than Tranſ.		—	—	—	—	—	—	0 10
Plank	In the Bottom		0 2	0 2	0 2½	0 3	0 3	0 3	0 3
	Under the Wale		0 3	0 3	0 3½	0 4	0 4	0 4	0 4
	Above ditto		0 3	0 3	0 3½	0 4	0 4	0 4	0 4
	At the Floor-heads within and without, two or three Strakes to be one, or one a half inch thicker than the Bottom; alſo two or three Strakes under the Clamps, and next the limber Boards of thicker Stuff, and a Strake or two of thicker Planks under the thick Stuff below the Wale, to diminiſh gradually till they are the thickneſs of the Plank in the Bottom								
Scarphs	Of the Keel long 3 times their Breadth		3 8	4 0	4 4	4 6	5 0	5 6	—
	Of the Timbers		4 6	4 8	5 0	5 6	5 8	6 0	6
Stem	Fore and Aft below		0 9	0 11	0 11½	1 0	1 1	1 2	1
	At the Head		0 10	1 1	1 3	1 4	1 5	1 6	1
	Falſe		—	0 6	0 6½	0 6½	0 7	0 7½	0
Steps	Main	Sided to the Diameter of their reſpective Maſts in Ships of War	—	1 6	1 8	1 10	2 0	2 1	—
	Fore		—	1 3	1 4	1 6	1 8	1 10	—
	Mizon		—	1 0	1 1	1 2	1 3	1 4	—

		ntlings of the Principal Pieces of Timber in Merchant Ships.						In Ships of War.	
Names of the Pieces.		Tons 80	Tons 110	Tons 220	Tons 330	Tons 440	Tons 600	Tons 900	Tons 1200
		Ft.In.	Ft.In.	Ft.In.	Ft.In.	Ft.In.	Ft.In.	Ft.In.	Ft.In.
Fore and Aft	At the Keel	0 11	1 2	1 4	1 6	1 8	1 9½	2 4	2 5
	At the Head	0 10	0 11	1 0	1 4	1 2	1 3	1 6	1 8
Thwart Ships	At the Keel	0 6½	0 6½	0 7	0 7½	0 8	0 9	—	—
	At the Head	0 9	0 10½	0 11	0 11½	1 2	1 4	—	—
foms	Wing	0 9	0 10	0 11	0 11½	1 0	1 1	1 0	1 0½
	Second	—	0 10	0 10½	0 11	0 11½	1 0	1 1	1 1½
	Third	—	0 8½	0 9	0 9½	0 10	0 11	1 0	1 0½
Sided	Lower Futtocks	0 9	0 10	0 10½	0 11	1 0	1 0½	1 1	1 1½
	Middle ditto	0 8	0 9	0 9½	0 10	0 11	0 11½	1 0½	1 0¾
	Upper ditto	—	0 8	0 8½	0 9	0 10	0 10½	1 0	1 0½
	Top Timb. at Heel	0 6½	0 7½	0 8	0 8¼	0 9½	0 10	1 0	1 0½
	Ditto ditto at Head	0 5½	0 5½	0 5½	0 6	0 6½	0 7	0 8¾	0 9¼
In and out	At the Floor Heads	0 6½	0 7	0 7½	0 8	0 8½	0 9½	1 0	1 1
	At the Breadth	0 5	0 5	0 5½	0 6	0 7	0 7½	0 10	0 10¾
	At the top of the Side	0 3	0 3	0 3	0 3½	0 4	0 4½	0 4½	0 4¾
es	Main broad	0 10	1 6	2 2	2 6	2 10	3 0	3 6	3 10
	Ditto thick	0 4	0 5½	0 6	0 6½	0 7½	0 7½	0 5½	0 7
	Channel broad	—	0 6	0 8	0 9	0 9½	0 10	1 2½	1 4
	Ditto thick	—	0 3	0 3½	0 4	0 4½	0 4½	0 4½	0 4½

To lay down a Ship of 79 Feet 7 Inches long, and extreme Breadth 22 Feet 8 Inches moulded; the Midſhip Timber from the Aſt-end of the Keel 46 Feet and a half; Height in the Midſhips of the lower Height of Breadth 9 and a hal the upper Height of Breadth 11 three Quarters, the Sheer 18 Feet; Dept in the Hold 9 and half, between Decks 6 three Quarters, Wing-Tranſom 16 Feet. Plate 2.

FIRST, Draw the Strait-line Q ⊕ k, and erect the Perpendiculars k O, Q W; ſet off the Rake of the Poſt from Q to q, and draw q W, for the Aft-ſide of the Poſt; then by the preceding Table of Scantlings ſet off the Breadth of the Poſt, and draw the Lines r o, to repreſen Fore-ſide of the Poſt and Rabbit. Set off from r to ⊕ 46 Feet and a half and by the ſaid Table of Scantlings ſet off the half Breadth of the Midſhip Timber fore and aft, and draw the Line ⊕ H, to repreſent the for and aft Sides of the Midſhip Frame. Set off ⊕ N, ⊕ M, for th lower and upper Heights of Breadths, and ⊕ H for the Height of th Sheer; k O the Height of the Stem, and Q W the Height of the Win Tranſom. Draw the Curve W M n for the upper Height of Breadth Line, and W N m for the lower; draw alſo O n, and form the Ste F V D C.

2. Set up the Dead-riſing from ⊕ to u, s to t, and e to V, and dra the Riſing-line to repreſent the Riſing of the Floor; then ſet off th Depth of the Keel, and draw the Line R S for the lower Edge of th Keel; draw alſo r g V for the Thickneſs of the Plank or Rabbit.

3. The next Thing is to Station the Timbers in the fore and aft Body, and to mark them with their proper Names. (*See Plate* 3.) Obſerv to ſet off the Breadths, Thickneſs and Depths of the Keel, Stem-poſt an Timbers, as in the Table of Scantlings.

4. Draw the lower and upper Decks, and their Riſings which are repreſented by the Faint-lines, the Decks are denoted by the ſtrong Lines; ſ off alſo the Height of the lower Edge of the Wales, the Waſte, *&c.*

5. The principal Parts of the Sheer-plane being finiſhed, the next to b formed is the Floor-plane. Let the Planes of the Timbers be continu downwards, and from the Point ⊕, ſet off from the under Edge of t Keel 11 Feet 4 Inches to X, and draw the Line F E, parallel to R

paſſi

paſſing through X. Set off 8 Feet from G to u, for the half Breadth of the Wing-tranſom, and draw the Curve u ⊕ E, to repreſent the main half Breadth-line; in like Manner draw the Curves for the half Breadth of the Floor, and of Top-timbers, as deſcribed, *Plate 1ſt*

6. To form the Timbers in the Body Plane: Let A B be the Breadth moulded in the Midſhips at ⊕; on C the Middle of A B, erect the Perpendicular C G, and draw Lines parallel thereto from the Points A B; from C ſet off the half Thickneſs of the Poſt aft, and the half Thickneſs of the Stem forward, and draw the Lines as directed in deſcribing *Plate the 1ſt*. Then take off from the Sheer-plane the Height of the Planes of the Timbers, between the upper Edge of the Keel and the Riſing-line, both fore and aft, and ſet them from C towards G in the Body-plane, and draw Lines parallel to A B, each Way for the half Breadth-lines correſponding to thoſe in the Floor-plane. In like Manner take off the lower and upper Heights of Breadth in the Sheer-plane, and ſet them off in the Fore-body-plane, from B towards b; and thoſe in the After-body from A towards a; and draw Lines parallel to A B; alſo ſet off the correſponding half Breadths from the Floor-plane. The next Thing to be done is o form the Midſhip Timber, as directed before in *Plate 1ſt*.

Thus the Center of the Sweep to be deſcribed from C, the lower Height of Breadth downwards, is always in the lower Height of Breadth-line, nd in this Projection is at c, and it is generally near its Interſection with the ine C G. The Center of the Floor-ſweep, by trial will be found at f, and he Reconciling ſweep at r. *Note*, the Center of the Floor-ſweep muſt be o ſituated, that when it is deſcribed it may juſt touch the Riſing-line, at he extreme Breadth of the Floor. The Midſhip Frame being formed, he Reſt may be determined, and drawn by Moulds; the next Thing is o form Ribband-lines, and Water or Level-lines, and if the Timbers ormed do not make fair Curves, they muſt be rectified, and the Timbers ormed from thoſe Ribband and Water or Level-lines: The Timbers eing adjuſted by theſe Lines, we may then form the Tranſom by Help f the ſaid Lines.

Make C G in the Body-plane equal to 24 T in the Sheer-plane, and ſet ff in the Body-plane (equal to G u) the half Breadth of the Wing-anſom in the Floor-plane. In like Manner ſet off the Heights of the her Timbers fore and aft from the Sheer-plane, and their correſponding readths in the Floor-plane, and draw the Curves a, e, i, o, u, and r, s, u, in the Body-plane. In uſing the hollow Mould, when it is applied the Curve of each Timber, and the ſtrait Part being produced to the

Middle-line, it will give you as many Points of Interſection as there are Timbers; and if theſe Heights above the Baſe be transferred to the correſponding Timbers in the Sheer-plane, and a Curve drawn through theſe Points is called a Riſing-ſtrait.

The Uſe of the Ribband *and* Water-Lines.

The Timbers are corrected, and properly formed in the Body-plane, by the Ribband and Level-lines drawn in the Floor-plane: To draw the Ribband and Water-lines on the Floor-plane, or Ribband or Level-lines. Firſt, draw a Water-line in the Sheer-plane, ſo as to coincide with the lowe Height of Breadth at the Midſhip Timber; and at equal Diſtances below this Water-line, draw two or more Water-lines parallel thereto. In th Sheer-plane N is the lower Height of Breadth in the Midſhips; and Level lines are drawn inſtead of Water-lines: Now having given the Draft o Water abaft more than afore, ſet it off from r upon the Stern, and dra a Blank Line parallel to the Keel, which will repreſent a Water-line, an parallel to this Line draw the Water-lines required.

To form the Water-Lines *on the* Floor-Planes.

Having transferred them to the Body-plane, from the Sheer-plane, b ſetting off their Heights on the Timbers, take the ſeveral Diſtances b tween the Middle-line in the Body-plane, and their Interſections with th Timbers, i. e. the Interſections of the Level-lines; transfer theſe Diſtanc to the correſponding Timbers in the Floor-plane, which gives you th Points through which the Curves muſt paſs. The Curves of horizont Ribband-lines are drawn in like Manner, as Water-lines.

To draw the diagonal Ribband-Lines *on the* Floor-Plane.

Theſe diagonal Ribband-lines, deſcribe as directed in the former Part this Work, and the Ribbands are to be drawn in ſuch Manner as to nearly perpendicular to the Timbers as may be convenient. Take Diſtances between the Point where the Diagonal cuts the middle Line, the Body-plane, and the ſeveral Timbers which ſet off on the Floor-pl upon their correſponding Timbers, both in the fore and after Body, you will have the Points through which the Curve muſt be drawn: Bu it be not a fair Curve, it muſt be altered ſo as to paſs as near the Po as can be admitted. After all the Ribband-lines are formed, the Timbers may be altered ſo as to agree with them; which is correcting the Timbers, by reverſing what was before done; thus take the Diſtances between the right Line F G, and the Curve of the Diagonal in the Floor-plane at each Timber, which ſet off upon the Diagonal from the Point where it interſects the middle Line, and you will have the Points in the Diagonals, through which the Curves of the Timbers muſt paſs; and if three or four of theſe Ribband-lines be formed, and Points ſet off in the Ribband-lines, as above directed, then the Timbers may be corrected in the Body-plane, and ſo be properly formed.

This Method of Whole-moulding will not anſwer for the long Timbers afore and abaft; they are moulded in the Mould left by a riſing Square in the bend and hollow Mould, the Moulds muſt be made to their proper Scantlings in Feet and Inches.

The Uſe of Sur-marks is to find the true Places of the Futtocks, and thoſe Marks are placed near the Heads and Heels of each Timber of the half Breadth Staff. This Staff is generally made of Deal, about an Inch and a half Square, and of a convenient Length; on one Side of it you are to ſet off the ſeveral half Breadths of all the Timbers in the after Body, and on the other Side thoſe of the fore Body; ſet off on the other two Sides the ſeveral Heights of the Sheer, the after Body on one Side, and fore Body on the other.

The Staff being marked, and the Floor Timbers faſtened on the Keel, and levelled acroſs; the Futtocks muſt next be faſtened to the Floor Timbers, and they muſt be ſet to their proper Half-breadths and Heights, by the Half breadth Staff, for which Purpoſe a ſmall Line, called a Ram-line is ſtretched from the middle Line of the Stem, to that of the Tranſom or Poſt, to this Line a Plummet is hung by a Line, ſo tied to the Ram-line, that it may ſlide upon it, and may be moved to the Plane of any Timber, and as the Plummet will hang perpendicular to the Keel, and in the Plane of the Sheer, therefore by it the Timbers may be ſet in proper Direction in reſpect of the Keel, and to their proper Half-breadths by the Staff; and when the two Sur-marks coincide, the Futtock will be at its proper Height and due Place.

Of the Cant Timbers.

Theſe Timbers are canted from the aftermoſt Floor-timber; the Reaſon of canting theſe Timbers is, that they may nearly be equally ſpaced at the

Breadth-ribband: And in order to ſpace them upon the Keel, the Can of the Faſhion-piece muſt be determined; in conſequence whereof, le the Plane of the Faſhion-ſheet interſect the Sheer and Floor-Planes in th Point G, draw the Line G u, and it will be the Inclination of the Faſhion-piece to the Floor and Sheer-planes; u being the upper End of the Faſhion-piece, at the Extreme of the Wing-tranſom; the Angle G u O, its Inclination to the Sheer, and u G g, to the Floor-plane. Erect a Perpendicula upon the Point g, and divide the Space between the Point g, and the fartheſ Cant-timber upon the Keel, into the ſame Number of equal Parts, tha the Space between that Timber and the Wing-tranſom on the Breadth-line is divided, and you will obtain the Cant of all the Timbers, by drawing Lines from the Points in G x, to the correſponding Points in th Breadth-line u V M. The Cant-timbers may be formed either by Water-level, or Ribband-lines.

The diagonal Ribbands are moſtly uſed, and they are diſtinguiſhed b the dotted Curve-lines in the Floor-planes: The horizontal Ribband correſponding, are formed as Level-lines, by ſetting off their horizonta Diſtances from the middle Line in the Body-plane, upon the Floor-plane.

Of the Tranſoms.

The Tranſoms are fixed to the Stern-poſt, as the Floor-timbers are to the Keel: They have a Riſing like the Floor-timbers, which is called the Flight; and the Wing-tranſom has a Round-aft, and a Round-up, which are at Pleaſure. The Deck-tranſom has a Round-up, much the ſame as the Beams; but in forming the Tranſoms, the Round-up is formed by the Beam-mould. You muſt aſſign each its proper Place upon the Poſt, and then find the Poſition of their Planes with reſpect to the Floor-plane; their Planes are always perpendicular to the Sheer-plane.

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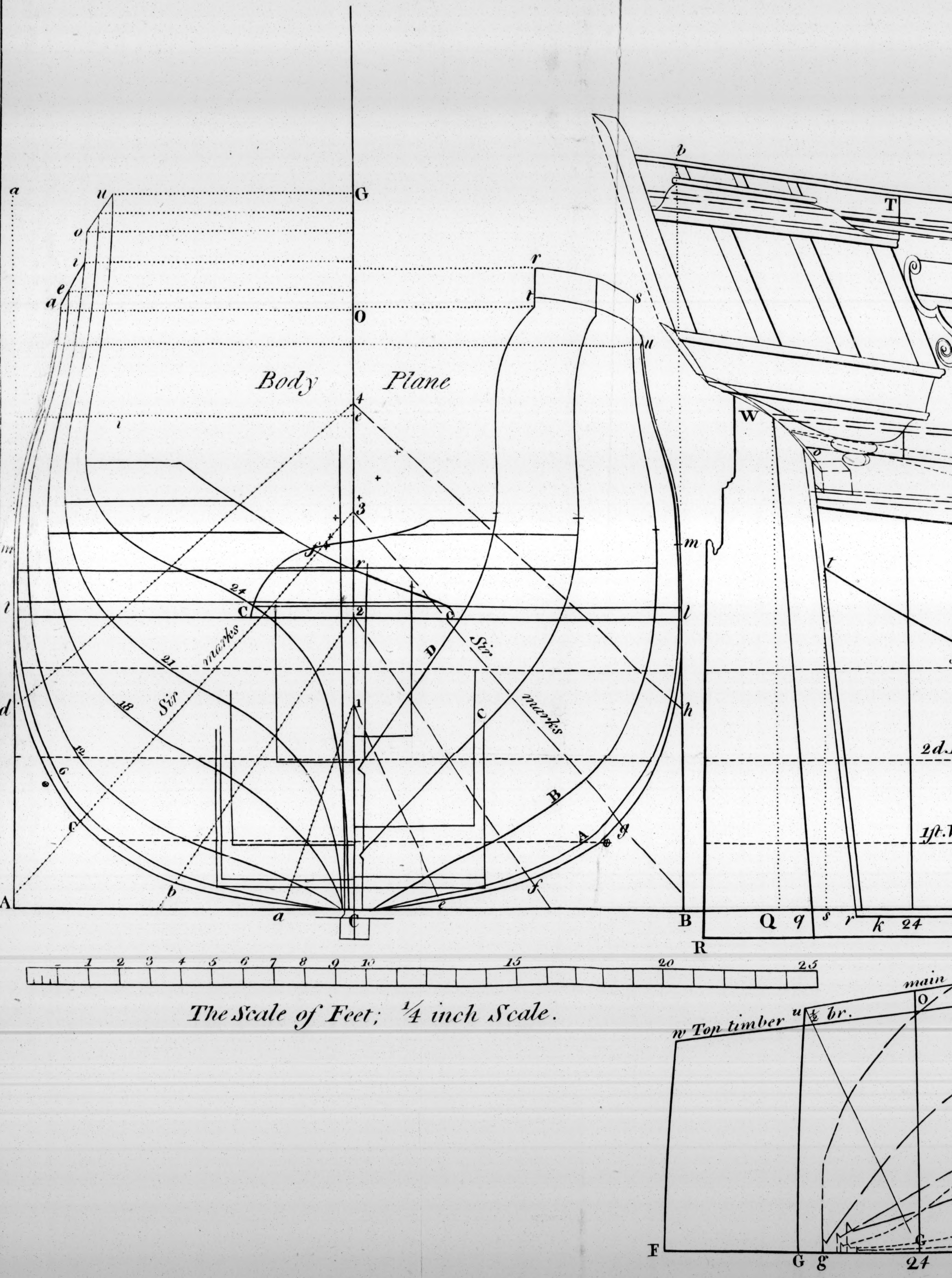
Plate 2d. facing page 72.



	F.	I.		F.	I.
Length on the lower Deck	79	7	– *of the keel kk*	77	4
Of the Keel for Tunnage	65	9	– 3/5 *of* 22 8 *is*	13	7
			rems.	65	9
Breadth Extream	22	8			
Depth in the Hold	9	6			
Burthen in Tuns	Nº 178½				

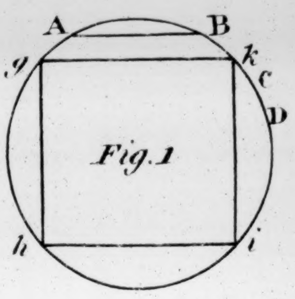
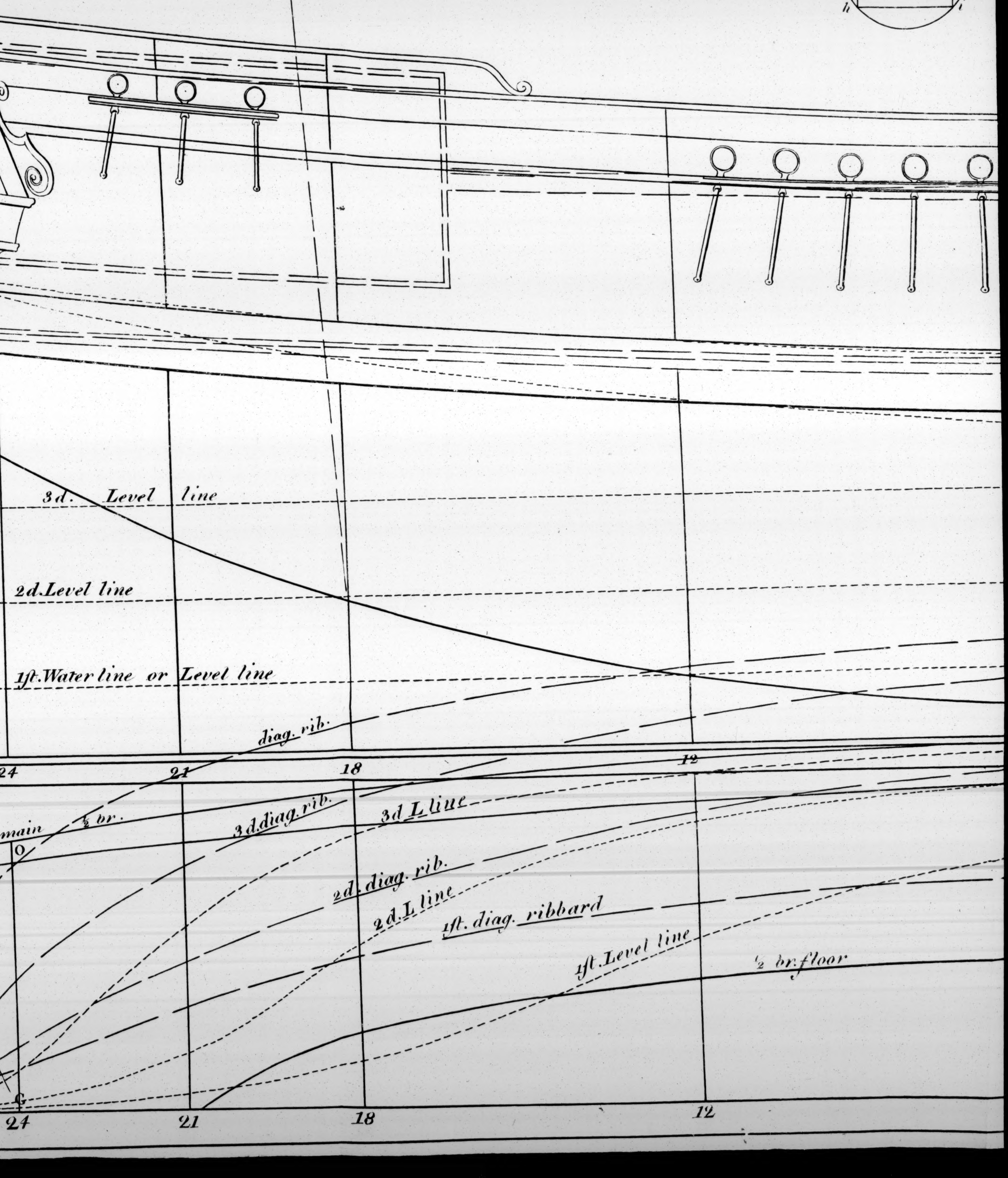


Fig. 1



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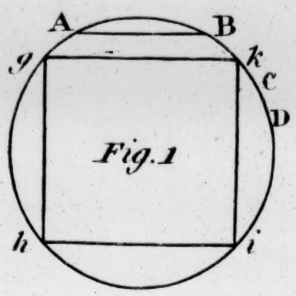
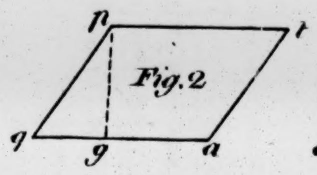
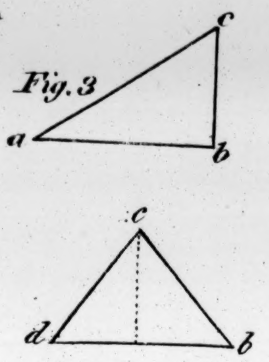
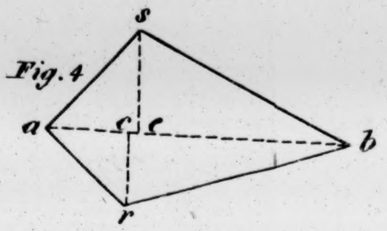
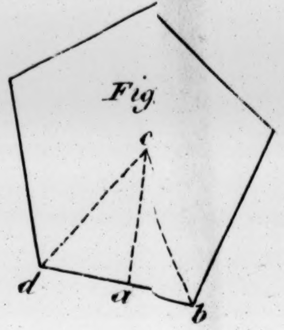
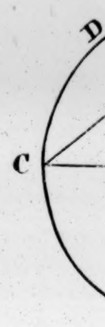


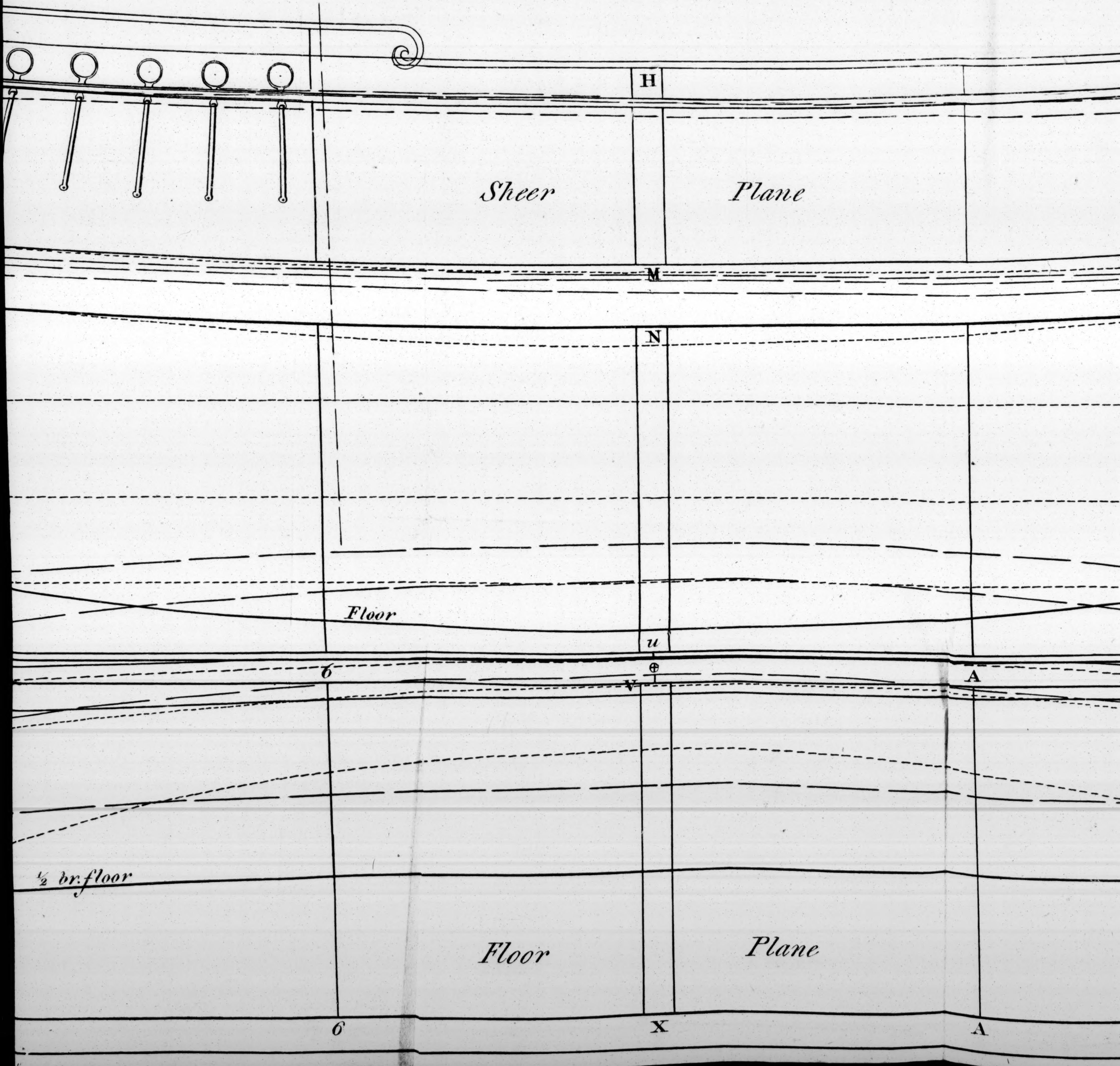












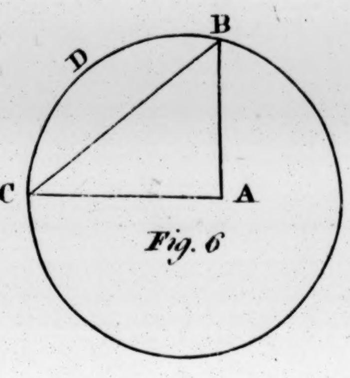
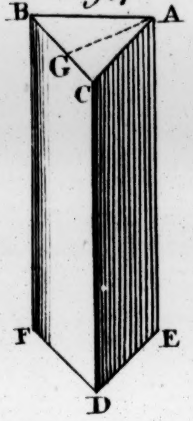
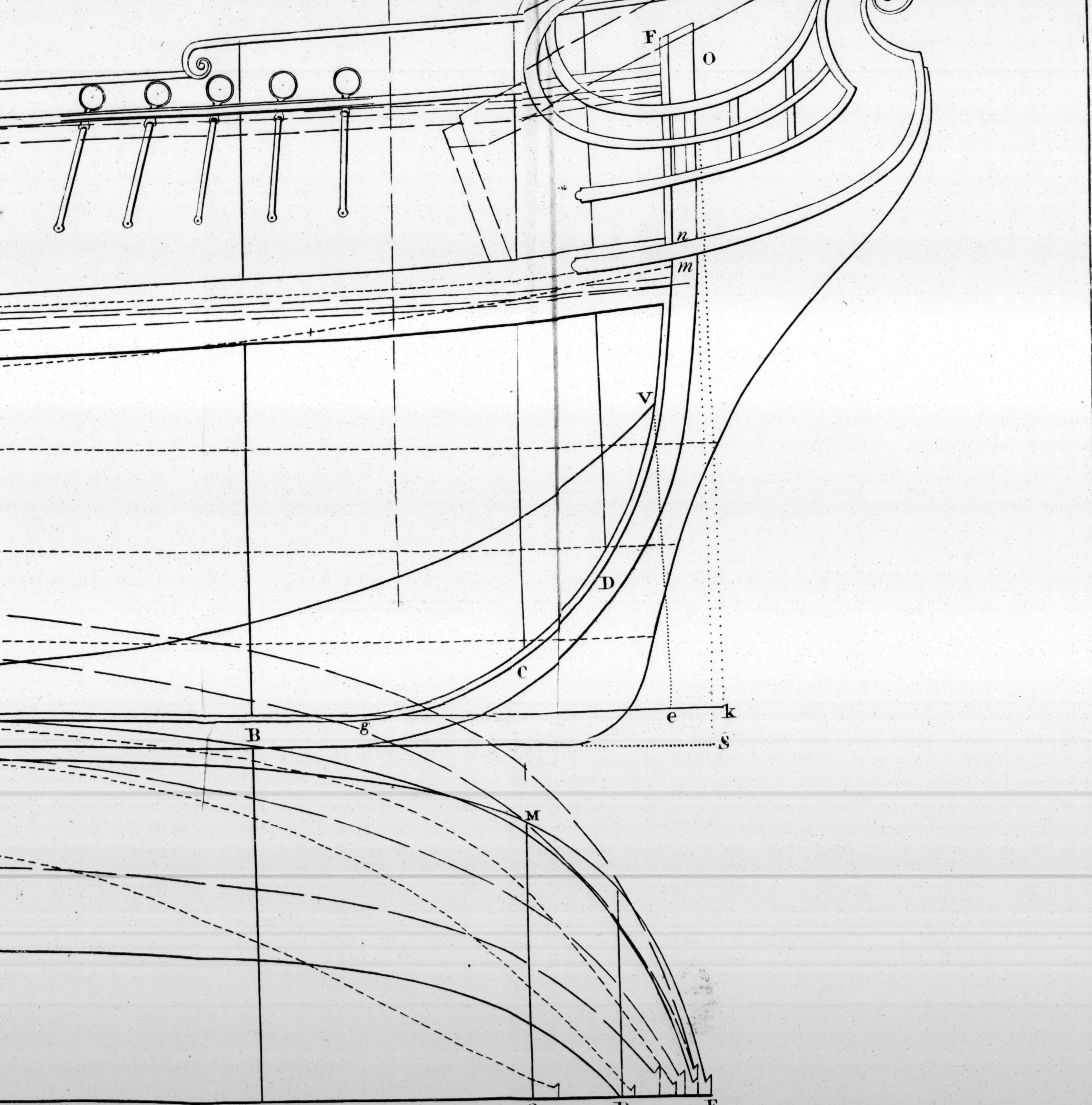


Fig. 6

Fig. 7





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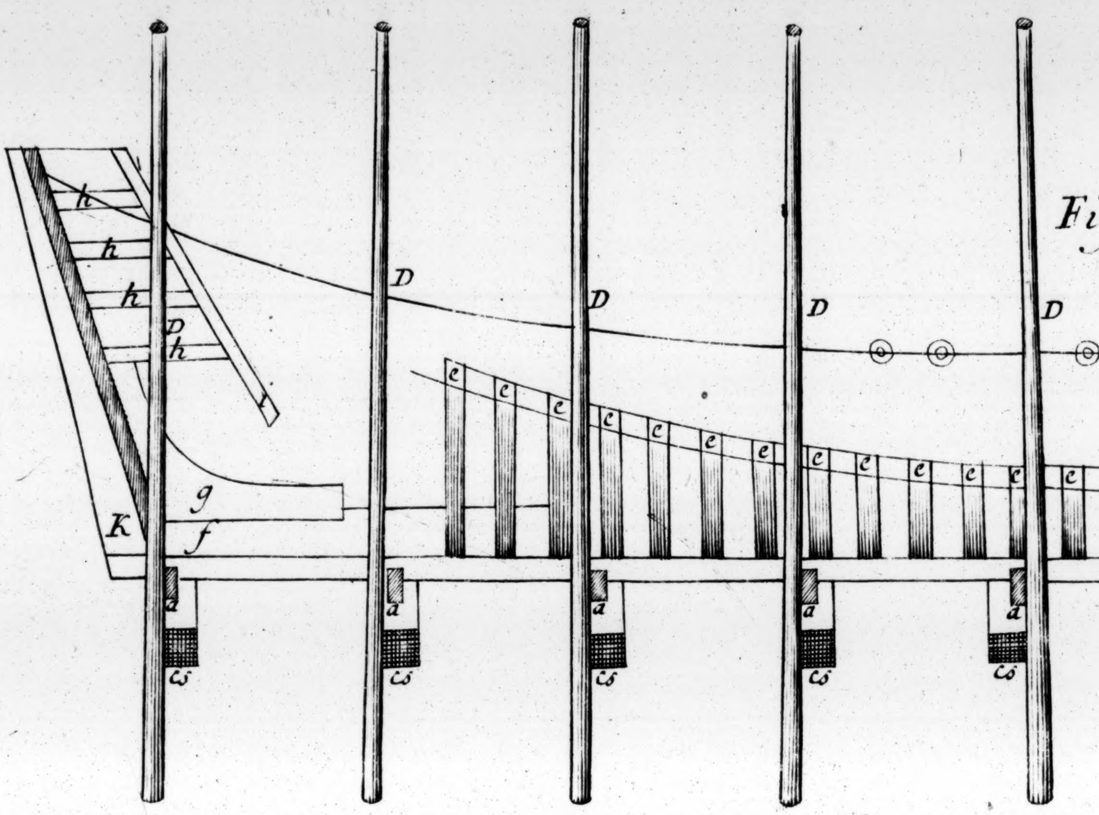
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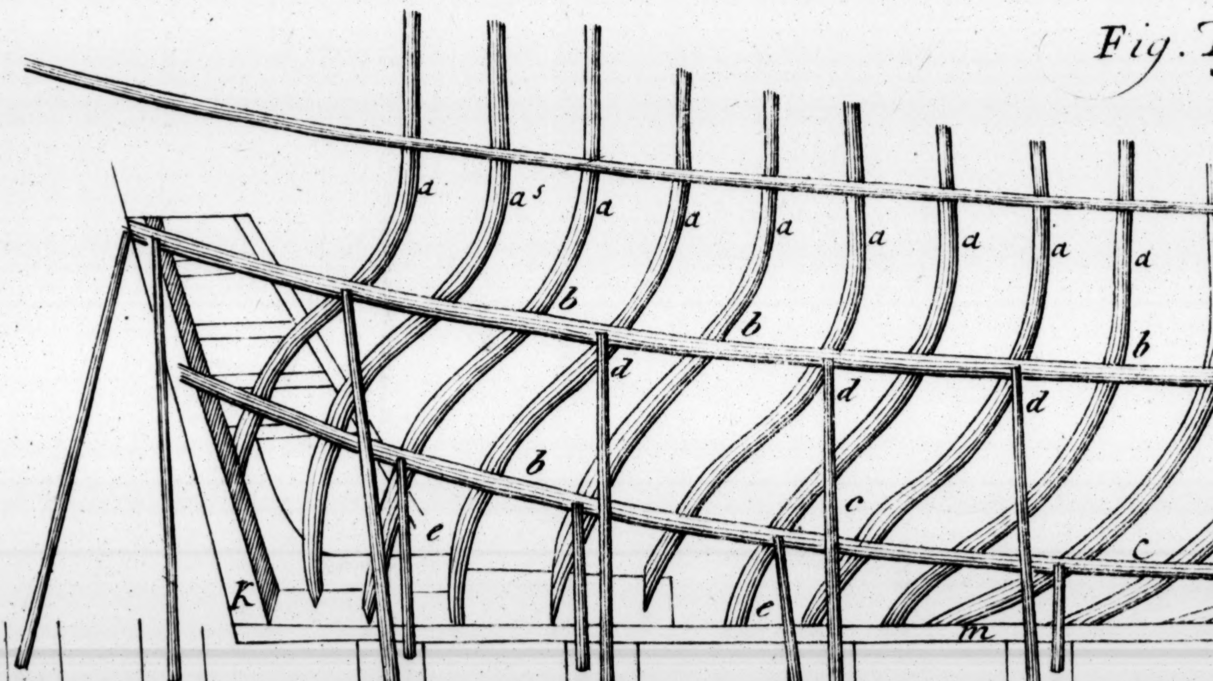
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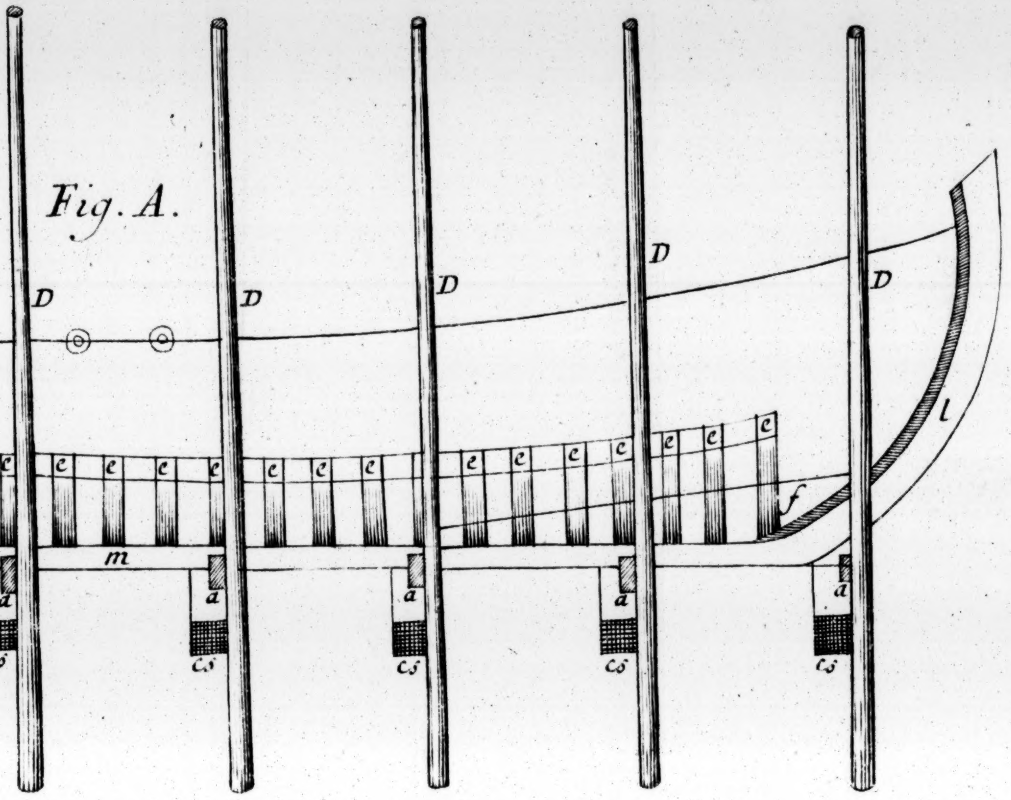
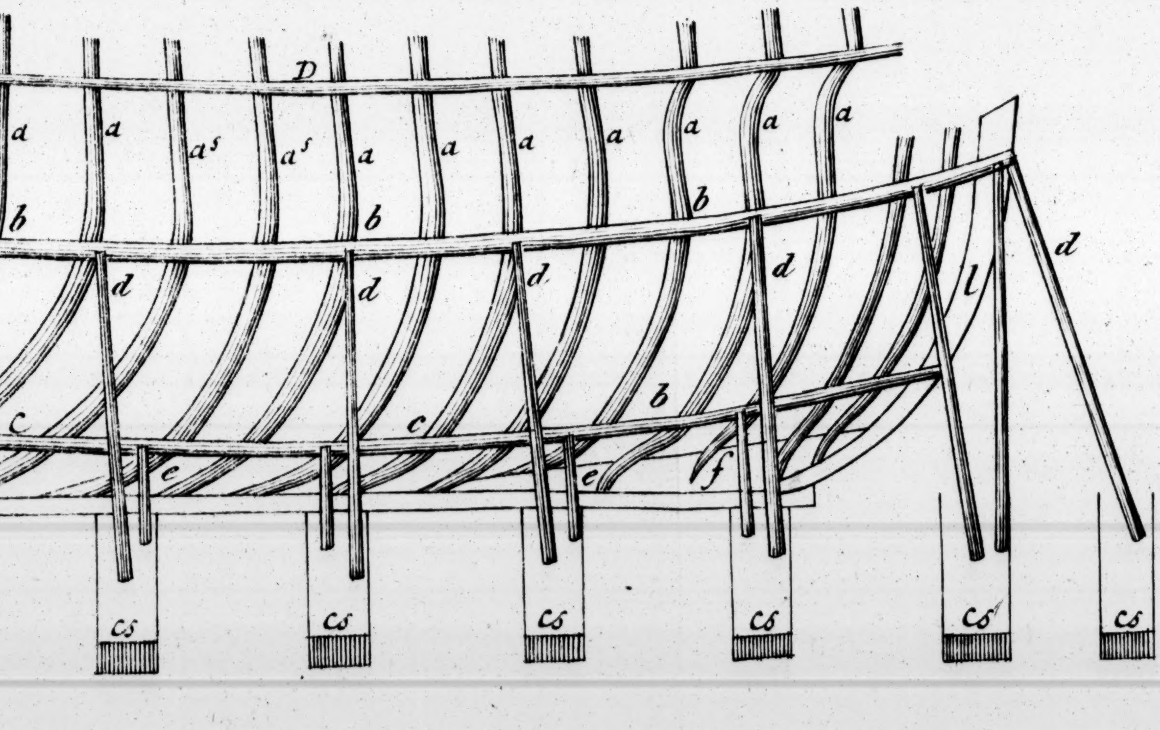
Fig. A.



ig. B.



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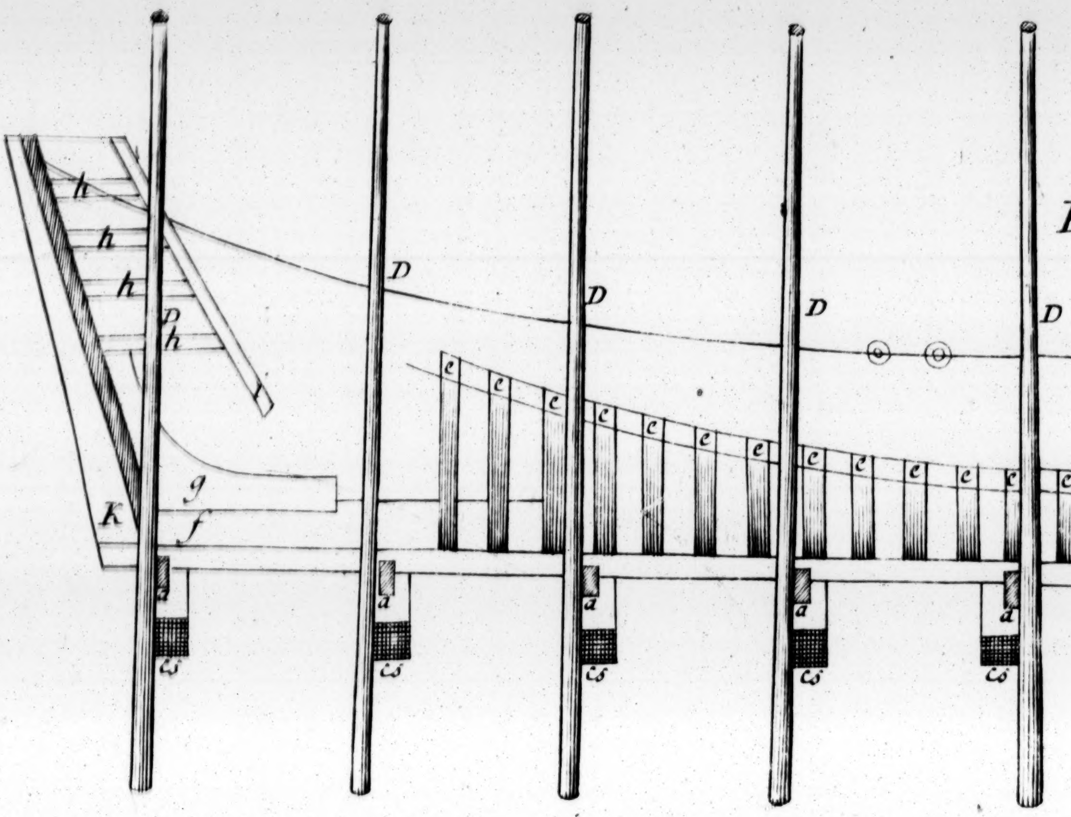


Fig.

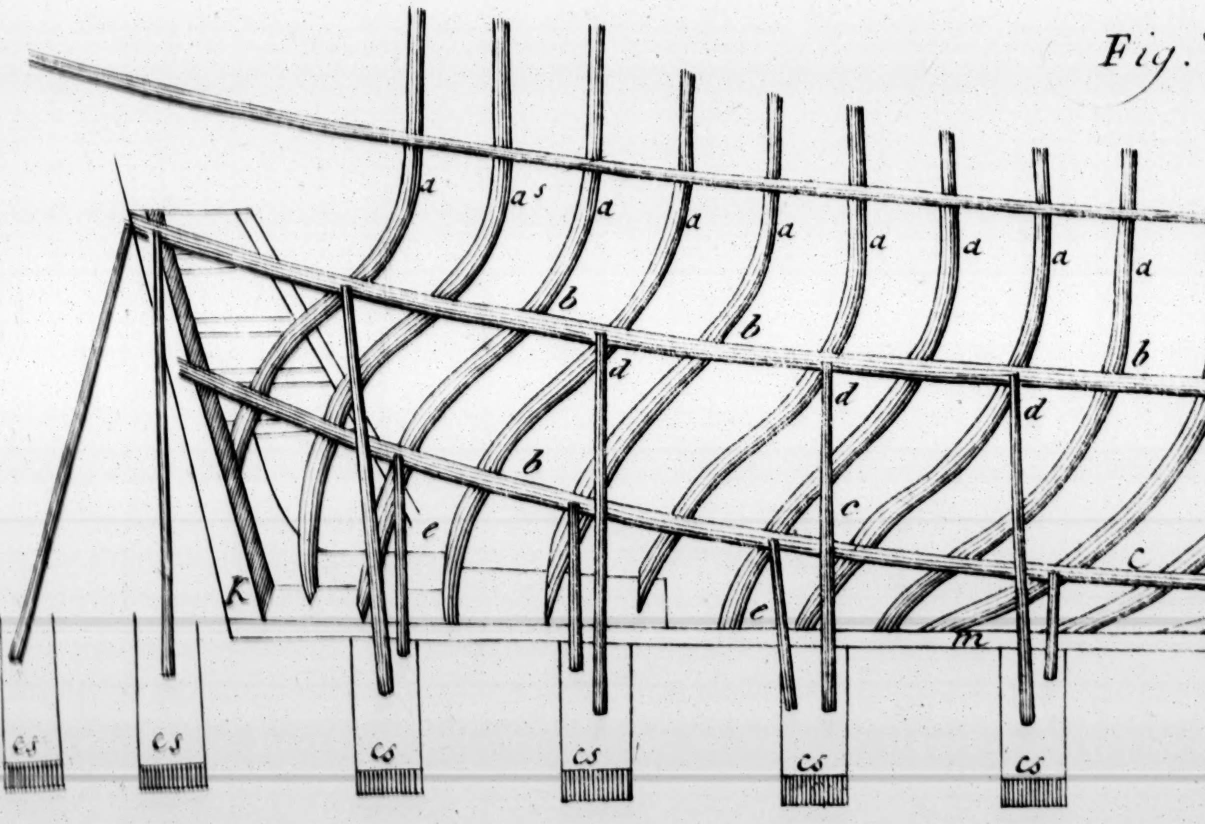


Plate III. *Facing* Page 72.

Fig. A.

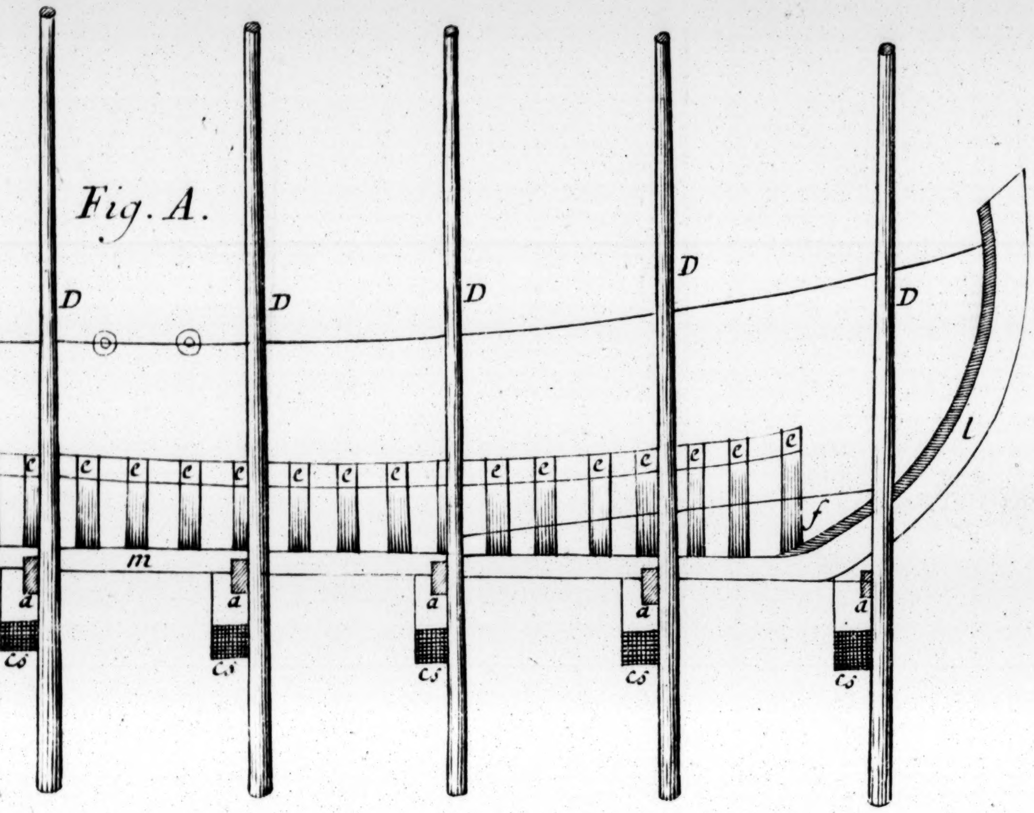
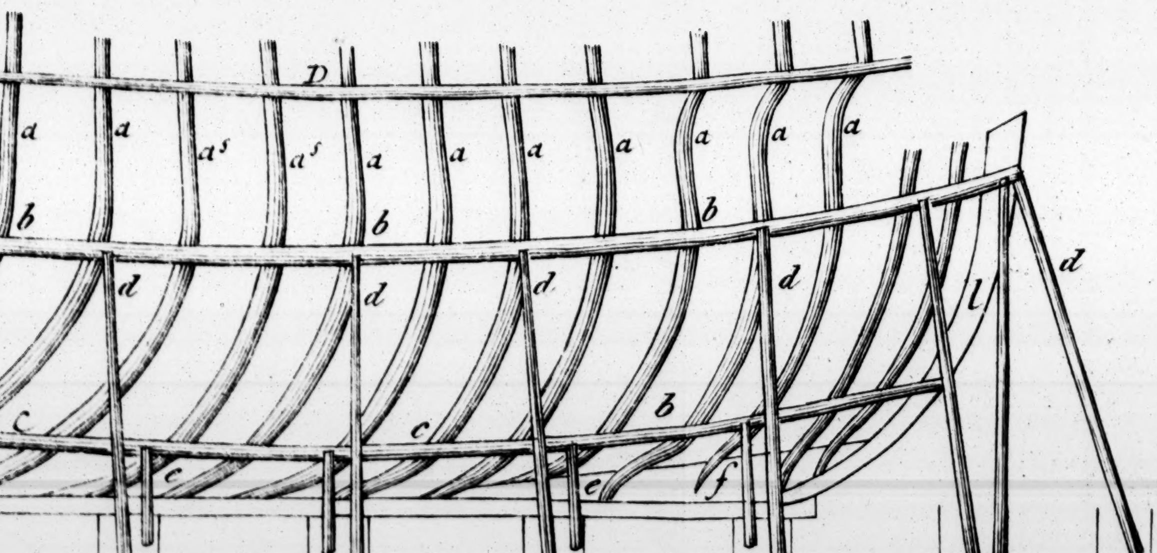


Fig. B.



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o lay down a SIXTY-FOUR GUN SHIP.

HAving made the Scale, which is a Quarter of an Inch to a Foot, draw p l, the Length of the lower Gun-deck 151 Feet out and out; and the Table of Scantlings, ſet off and draw the lower Edge of the Keel d the Rabbit, and then ſtation the Timbers, and draw them; ſet off the ad-riſing from ⊕ and cutting down Line, which Lines draw, ſet off e Height of upper and lower Wales, Heights of Breadth, lower Gun-ck, upper ditto, Quarter-deck, Forecaſtle, &c. which being done, ſet f the Rake of the Poſt, and draw it, and then ſet off the Stem, and draw as before directed.

The Height of the lower Wale ⊕ m 16 F. 9 In. Upper 20 F. 9 In. eer ⊕ M 32 Ft 10 In, Height of the lower Gun-deck at Midſhips, F. at the Stem 22 F. Height of ditto at the Poſt 23 F. Height of e Deck-tranſom p d, 23 F. Wing-tranſom p G 25 F. Which done, aw the Line as per Plan; the lower Gun-deck is denoted by a broken ine, and the Harpin by a dotted Line.

The next Thing to be done is to ſtation the Ports; their Heights above e Deck by the Table is 2 F. 3 In. Height of the Ports 2 F. 8 In. eadth 3 F. and Diſtance between the Ports 8 F. 2 In. as per Table of rts.

The Faſhion-piece is repreſented by the Line F G h: Theſe being awn, the other Requiſites may be projected as per Plan. The Sheer-ane being finiſhed, we proceed to the Floor-plane, which Particulars are ojected as deſcribed before in Plate 2d. Hence V x = 21 F. the main alf-breadth; and x u = 16 F. the Half-breadth of the Top-timber in e Midſhip Frame.

q O the main Half breadth aft, and e f at Timber H.

q g and R h the Top timber Half breadth aft, and e f at Timber H.

Now draw fair Curves through theſe Points, and then proceed to the dy-plane; where A C = C B = x V in the Floor-plane.

A D = B E = ⊕ m the Height of the Top of the Midſhip-timber.

C L = 8 L, and C G equal p h; and the half Breadth of the different mbers, *viz.*

Floor-plane	Body-plane
Main ½ Breadth	= b ⊕
At Timber C	= o C
Timber E	= o E
Timber G	= o G
Timber H	= o H
Top Timber ½ Breadth	—— ——
x u	= o ⊕
Timber C	= o k
E	= i h
G	= e g
H	= e f

The after Body ½ Breadths at

Timber ⊕	b ⊕ and o ⊕ the main & upper
3	o 3 and a 3.
5	o 5 and i 5.
7	o 7 and a 7.
8	o 8 and L 7.

q o = the ½ Br. at the Wing-tranſom
q g = Gu, the ½ Br. near the Top
R h = the ½ Br. aft. of the faſhion P.

Thro' theſe Points the Timbers are formed in the Body-plane, which being done, and the Diagonal-ribbands, and Level-lines drawn, the Diagonal Ribband-lines are numberered 1, 2, 3, 4, both for the fore and after Body, and the Level-lines are marked L L in the Body-plane.

In the Floor-plane 1ſt D. R, 2d. D. R, 3d D. R, and 4th D. R are the firſt, ſecond, third, and fourth Diagonal Ribband-lines, which are transferred from the Body-plane, and Curves drawn, as directed in laying down the Merchant Ship.

In the Floor-plane f u repreſents the Poſition of the Faſhion Piece, in reſpect of that Plane, for the Point u is ſuppoſed to be the End of the Wing-tranſom, and this Line f u ſhews the Cant of the Faſhion-piece.

The Form of the Faſhion-piece, and the Cant-timbers fore and aft, may be projected in the Body-plane, but the Manner of their Projection being difficult to be underſtood without Practice in the Art of Ship-building; therefore I muſt refer the Reader to the practical Proficient.

The Heights of the Riſing-line or Floor-plane in the Sheer-plane, are ſet off from C in the Body-plane, and the ½ Breadths of the Floor at the ſeveral Timbers drawn, and from their Extremes, Perpendiculars are erected to ſhew the ½ Breadth, at thoſe Timbers more clearly.

Of MEASURING SHIPS.

IN order to Meaſure, or find how many Tons a Ship will carry, Shipwrights generally make Uſe of the following

RULE.

Multiply the Length of the Keel by the greateſt Breadth, and that Product by the half Breadth; then divide the laſt Product by 94, *and the Quotient will give the Tonnage required, for Merchant Ships; but for Men of War, the laſt Product muſt be divided by* 100.

Example. Suppoſe the Length of the Keel be 93 Feet 6 Inches, and the Breadth 32 Feet, required the Tonnage of the Ship.

```
Length of the Keel ———— 93.5
Breadth ———————————————— 32
                        -----
                         1870
                        2805
                        -----
                        2992.0
Half Breadth——————————    16
                        -----
                       179520
                       29920
                       ------
                   94)47872.0(509.2
                      470
                      ----
                      ..872
                        846
                       ----
                        .260
                         188
                        ----
                         .72
```

Hence a Ship of the above Dimenſions, will carry 509 Tons, and moſt three Tenths of a Ton.

But it is often neceſſary to find the Tonnage of a Ship when ſhe is a float, and conſequently the Length of her Keel cannot be meaſured. In ſuch Caſes Shipwrights make Uſe of the following

RULE.

From the extreme Length, ſubtract three fifths of the extreme Breadth, the Remainder is the Length of the Keel; then multiply the Length of the Keel by the extreme Breadth, and that Product by the half Breadth; which laſt divide by 94 for Merchant Ships, and by 100 for Men of War; the Quotient is the Tonnage as before.

But as in all Ships there is, or ought to be, a juſt Proportion obſerved between the Length by the Keel, the Breadth by the Beam, and the Depth in the Hold; as alſo for the Rake fore and aft, &c. the Uſe or Trade the Ship is intended for being conſidered: Therefore in finding the Tonnage of a Ship, regard ought to be had to the Depth of the Hold, as well as to the Length and Breadth; tho' this is generally neglected in Practice. We therefore offer the following Method for meaſuring Ships, as more conſonant to both Reaſon and Experience.

It is certain that if a Ship is gaged by taking only the Length of the Keel, from the Heel to the fore Foot, as the Length of the Ship, all the Rake fore and aft is left; but to prevent this Error, they allow in Ships built for Burden, three-fifths of the Breadth for the Rake fore and aft, therefore the half of that, which is three-tenths of the Breadth, added to the Length of Keel, or ſubtracted from the whole Length of the Ship from Stem to Stern, reduces the Ship to very near a regular Solid, whoſe three Dimenſions being multiplied together (as in other regular Solids) gives the ſolid Content, which divided by 93, the Quotient is the Tonnage of the Ship ſo meaſured.

To illuſtrate theſe Rules the better, we ſhall propoſe a Ship of the following Dimenſions.

	Feet
Length by the Keel ——— ——— ——— ———	82
Whole Length, Rake and all ——— ——— ———	98
Conſequently the Rake fore and aft ——— ——— ———	16
Breadth at the Beam ——— ——— ——— ———	26,5
Depth in the Hold ——— ——— ——— ———	12

Length by the Keel — — — 82
Half Rake fore and aft add — — 8

Sum — 90

Multiply the Breadth in Feet and Decimals — 26.5
By the Length — — — — 90

Product — — — — — 2385
Multiply by the Depth in Feet — — 12

Divide (always) by — — — 93)28620(307,6
720

600
558

42

The Burthen is 307,6 Tons, or nearly 307 Tons and three Quarters.

e general Rule for finding the Tunnage of Ships of War, and of Ships taken into His Majeſty's Service.

Here follows an Example of the Ship, delineated in Plate 2d.

Having ſet off two Inches and a half for each Foot of the Perpendicular, hen find the Reſidue of the Keel to be 79 Feet 4 Inches: And three mes 22 Feet 8 Inches is 68 Feet, which divided by 5 is 13 Feet 7 ches: This ſubtracted from 79 Feet 4 Inches, leaves 65 Feet 9 Inches Length for Tunnage.

	Feet	Inches	
e extreme Breadth — —	22	8	
hich multiply by — —	22	8	
	484	0	
	14	8	
	14	8	
	0	5	4
Its Square is —	513	9	4 = 513,78 nearly.

Multiply by 65,75

256890
359646
256890
308268

Nearly the Tunnage required. 188)33781,0350(179,7

The Length of the Keel for the Merchant's Service — 7933 Feet
Square of the Breadth — — — 513,78

The Product 40752,1674 divided by 188 gives — 216,77 Tons

Hence the Merchant's Tonnage is — 216,7
The King's ditto — — — 179,7

The Difference is — — — 37,0 Tons.

CHAP. VI.

Of laying the KEEL, *and erecting the ſeveral* TIMBERS, *&c.*

HAVING explained the Method of delineating a Ship, and formed the ſeveral Moulds neceſſary for hewing the Timbers to a proper Shape; we ſhall now proceed to the Manner of erecting and placing the various Pieces of Timber, ſo as to compleat this grand Machine.

The firſt Thing neceſſary is to prepare a proper Platform for ſupporting the Ship, and alſo for laying the Bulgeways on: This Platform is compoſed of ſeveral large Pieces of Timber, in Proportion to the Magnitude of the Ship, and are called Ground-ways. Upon theſe Ground-ways are placed Blocks of hard knotty Stuff, to raiſe the Foundation; upon which are laid other Blocks, called Splitting-blocks, of the freeſt Timber that can be procured, for the Conveniency of cleaving out again, when the Ship is ready to launch. On theſe Blocks the Keel is laid: When the Keel is hewed, ſcarfed, and rabitted, it muſt be placed very ſtrait and level; and if let an Inch and an Half into the Splitting-blocks, it will be much the better ſecured in its proper Place.

When the Keel is truly placed, and properly ſecured, ſet off the exact Length fore and aft, from the Riſing of the Keel, or Place where its upper Part ceaſes to be ſtrait, called by Shipwrights the Touch.

The exact Length of the Keel being ſet off, ſcarf the Keel to the Stem, and the Poſt to the Keel, raiſing the Stem and falſe Stern, or, as Shipwrights call it, the Apron, together, if it be a ſmall Ship; and alſo the Stern-poſt, with Tranſoms, or Faſhion-pieces, joined together: But if it be a large Ship, then only the Poſt, or perhaps the upper and lower Tranſom, having always ſuch a Regard to the Weight, that the Machine

&c.

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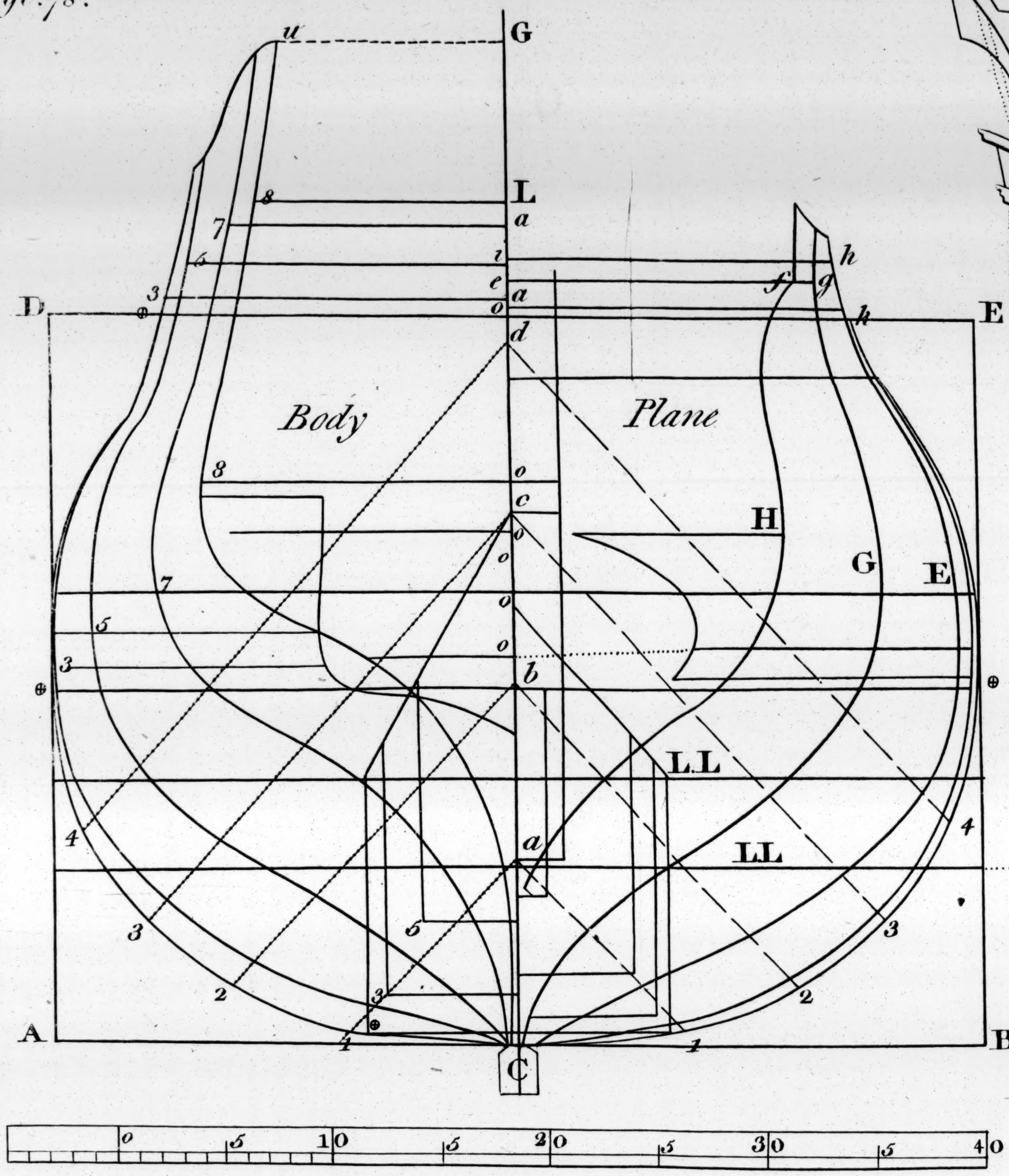


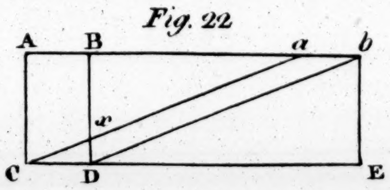


Fig. 22

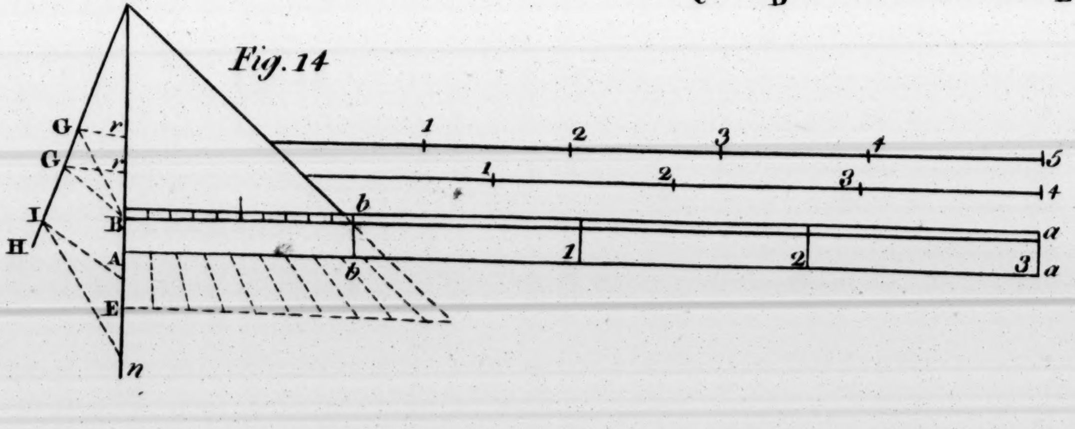


Fig. 14

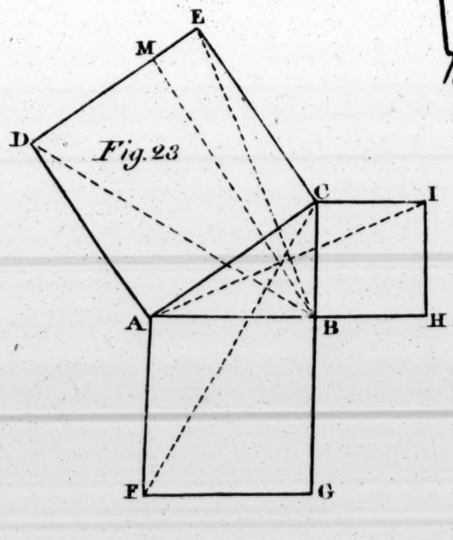
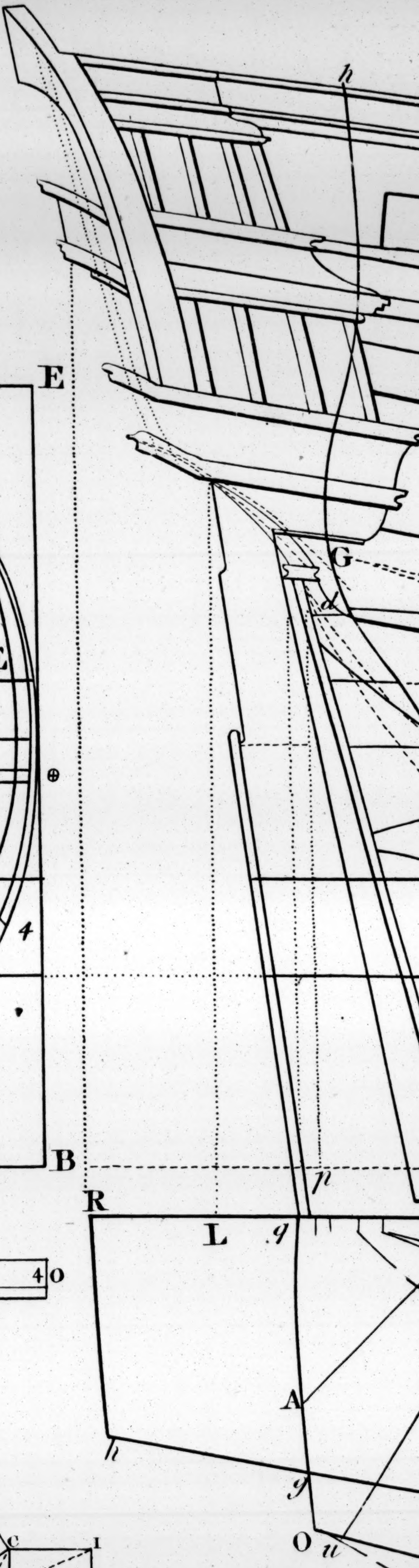
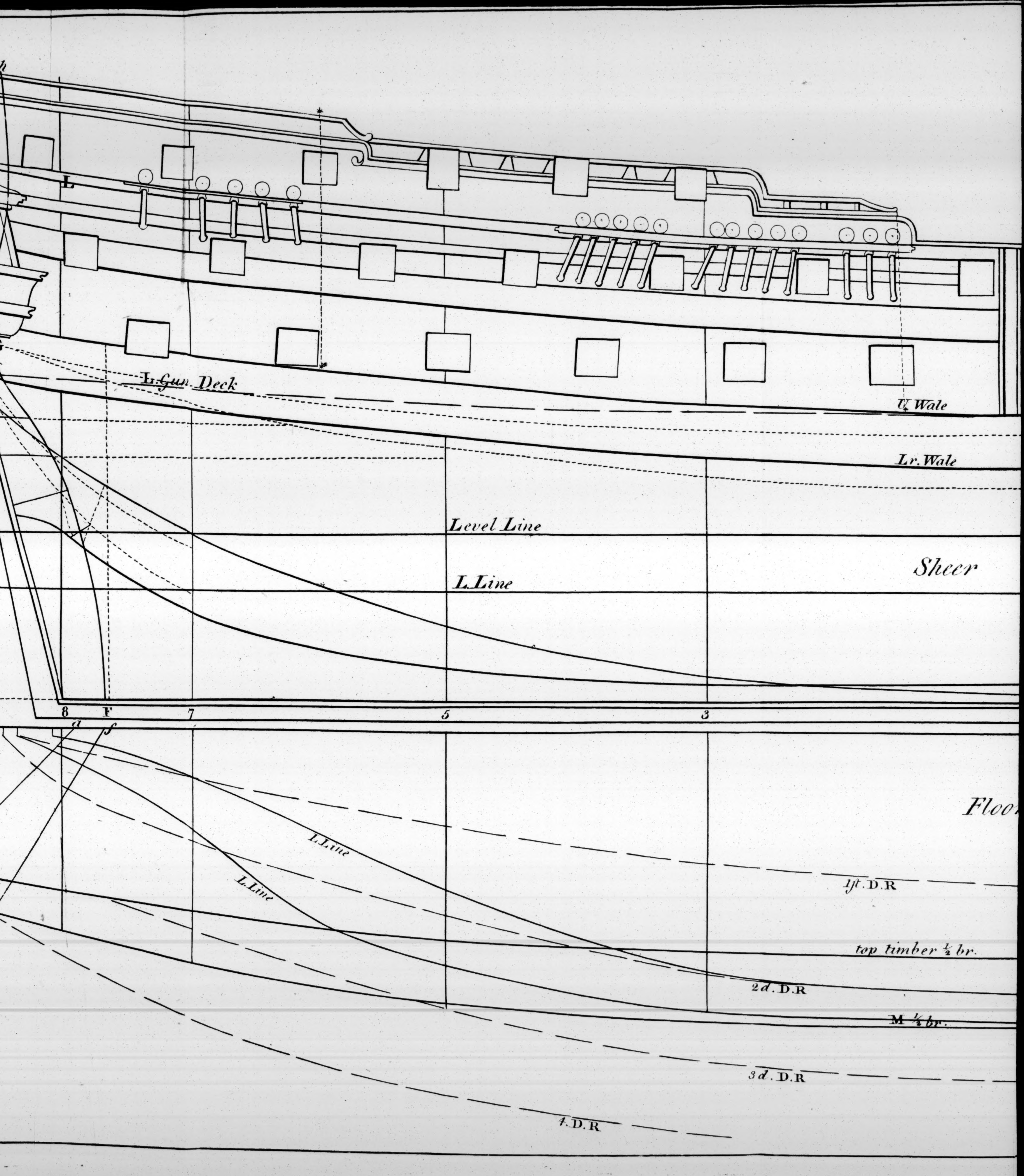


Fig. 23

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L. Gun Deck
U. Wale
Lr. Wale
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Sheer
L. Line
8
F
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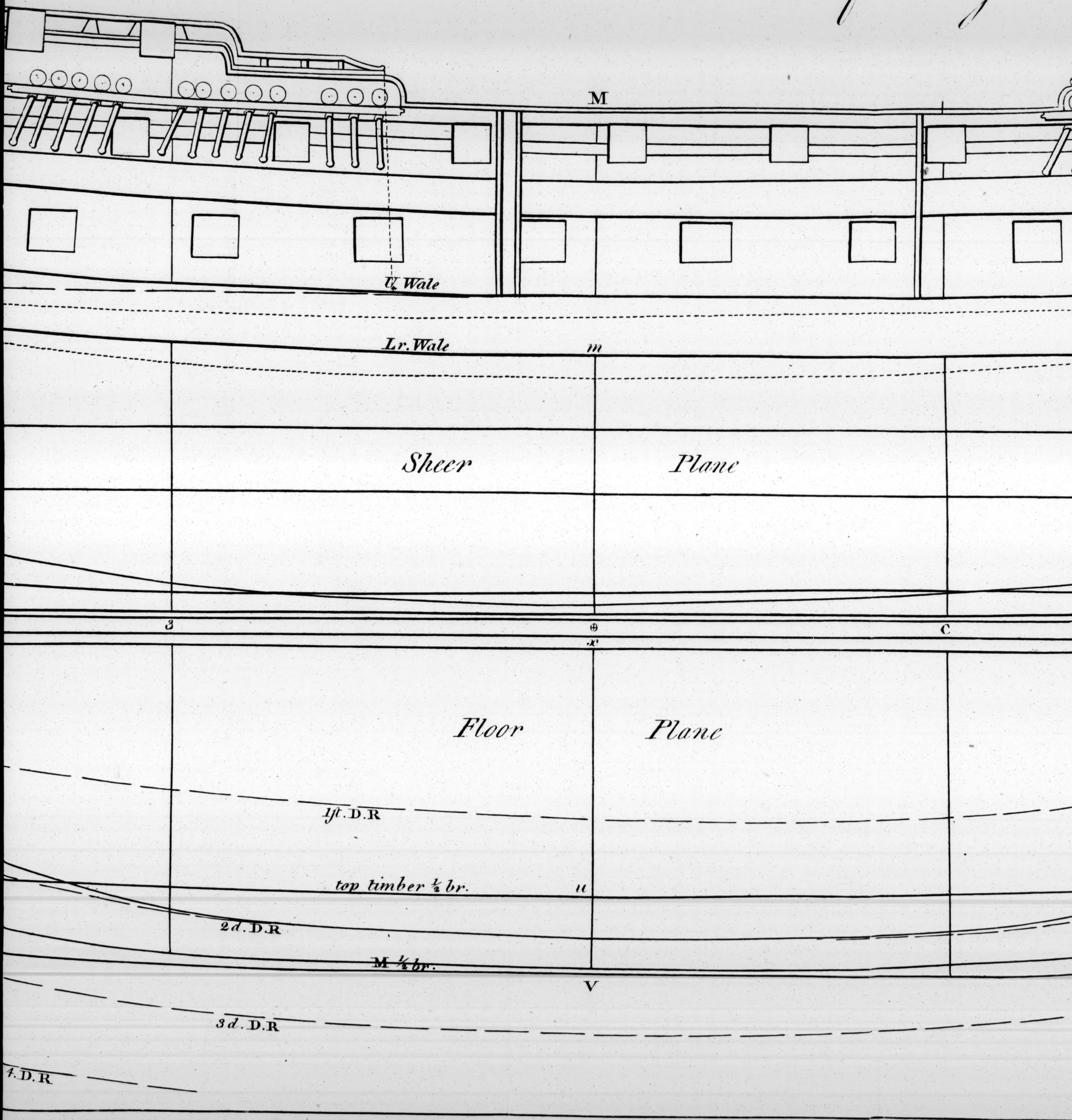
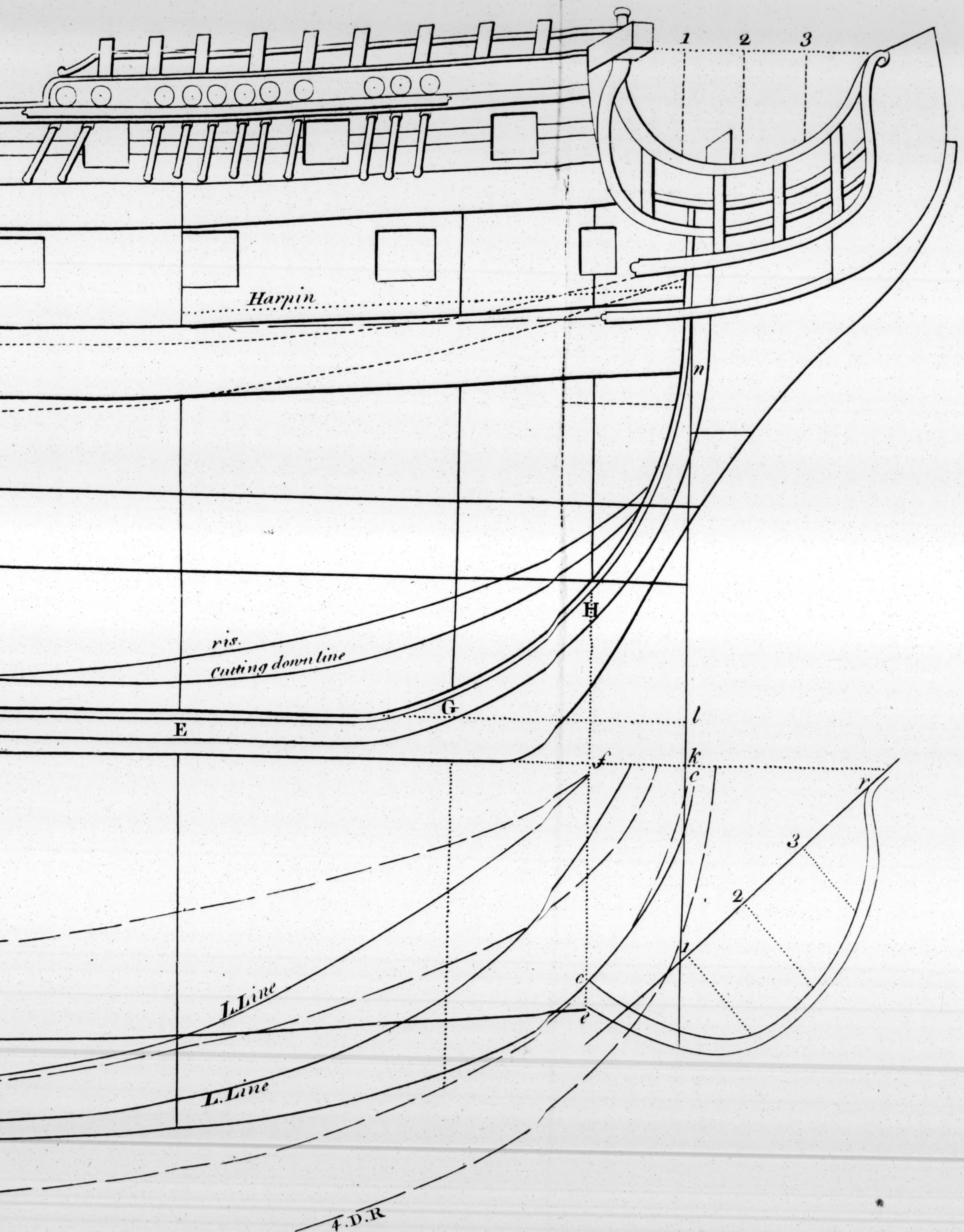
a
f
Floo
L. Line
L. Line
1st. D.R
top timber ½ br.
2d. D.R
M ¼ br.
3d. D.R
4. D.R

The Section of a 64 Gun



n Ship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d its Purchaſe are ſufficient for the Purpoſe, without hazarding either
en or Materials. And this Caution ſhould be conſtantly obſerved thro'
whole Work.

Be very careful that the Stem and Stern-poſt are placed truly with the
el, not winding in any Direction, and alſo Perpendicular, which is done
drawing Middle-lines on them: That the Tranſoms are level, eſpecially
Wing-tranſoms; and that all be well ſecured with Shores, placed on
mber Foundations, called Shoals, and firmly nog'd or trig'd.

In croſſing the Floor-timbers, great Care muſt be taken not to tear the
bbit in the Keel. The Frame-timbers are to be firſt erected, which
ſome Ships are every fourth, and in every others every third; but in
oſſing the Floor-timbers, every other Timber is commonly put on, and
lted through the Keel. Then hang up a Ribband at the Floor Sur-
rk, and if the Floor is fair, or riſes gradually, nail that Ribband, and
ore it with Pieces of Timber, ſtout enough to bear the Weight that may
put upon them. Obſerve to level the Floor very exactly, ſince it is the
ſt and principal Seat which bears the Ship; then nog all the Shores very
urely, fit in all the Floor-timbers, and get in all the Dead-wood, both
e and aft. Let in all the Half-timbers, and then get in your Kelſon.
careful to ſcore the Kelſon on all the Floor-timbers, ſcarf it, and bolt
through every other Floor-timber and the Keel. The other Floor-tim-
rs were before ordered to be bolted through the Keel.

The general Method is to frame every third, or every fourth Timber;
at is, to fit or join all the Foot-hooks and Top-timbers together, if it be
mall Ship; but if a large one, then all the Foot-hooks to the Breadth-
band; but in either caſe be careful to join the Frame-timbers very
actly, and true to the Mould. Let a Ribband be faſtened on at the
eadth Sur-mark in ſuch a Manner, if poſſible, that you may get on one
ale before you take it off again. When you have croſs-paled theſe
ames, ſhore the Ribbands, laying Shoals under. Then level the Sur-
rks, and ſet the Moulding-edges exactly perpendicular to the lower
ge of the Keel: For theſe Breadths Sur-marks, being the ſecond Seat of
aring, whether they are conſidered apart, or with Relation to the whole
ame, it is evident, that if the Floor Sur-marks and Breadth Sur-marks
not truly levelled, your whole Work will be ſpoiled; for let your
ſign be ever ſo good, if you neglect this Caution, your Ship will in-
itably be lapſided; that is, the Radii will not be equal from the Center,
d the Perpendiculars and Parallels will decline from the Horizon.

Plate 3, *Fig.* A, ſhews the Floor-timbers e, e, e, placed on the Keel m.
D a Ram-line faſtened to the Stem and Stern-poſt, and bent into a
Curve

Curve by Weights placed at n n. The Dead wood afore and abaft f, f. The Knee on the Dead-wood g. Tranſoms h, h, h. The Faſhion-piece i. The Stern-poſt K. The Stem l. The Keel m. The Splitting-blocks c, c, c. The Ground ways a, a, a.

Figure B ſhews the Frame bends a, a, a. The Ribbands b, b, b. The Floor C, C, C. The Double-depth-ribband D, D, at the Sur-mark of the Top-timber. The Ground-way c s, c s, c s. The Shores at the Breadth Sur-mark d, d, d. The Shores at the Floor Sur-mark e, e, e.

CHAP. VII.

Of CONVENIENCY.

TO contrive the Cavity of a Ship in ſuch a Manner, that it may admit of the due ranging and diſpoſing of every Thing neceſſary to be contained therein, is called Conveniency.

Hence a Ship ought not to be too long for her Breadth, or too ſhort for her Depth; but her Shape and Proportion adapted to the Uſe for which ſhe is deſigned.

Where there is not a Proportion of Length, Breadth, and Depth, great Inconveniency muſt be the Conſequence. For if a Ship of 20 Feet broad, can be made to perform the ſame Service as one of 22, it is evident, that the latter will have one Foot on each Side more than the other to reſiſt her Motion. Beſide extreme Breadths, as well as Depths, will cauſe a Ship to roll very much. Nor muſt a Ship have Length beyond a due Proportion; for notwithſtanding ſome have pretended that Length would increaſe Motion, yet Experience, that Touchſtone of Truth, has ſhewn that they are miſtaken. And it muſt be conſidered, that a more than ordinary Allowance of Timber is requiſite to make extremely long Ships equally as ſtrong as ſhort ones. Beſides, Sir *Iſaac Newton* has demonſtrated, that the Solid of leaſt Reſiſtance is blunt-headed, and conſequently, extreme Lengths will be uſeleſs in forming Bodies for dividing Fluids.

Theſe are the principal Things requiſite to be conſidered, in order to compleat this Part; but with regard to the others they may be differently extended, according to the Uſe the Ship is intended for, ſome Ships requiring to be deeper in the Hold than others, and perhaps that Depth may be ſpared out of the Height between Decks.

Obſerve that the Keel, Stem, and Stern-poſt are properly adapted to the other Parts, ſo that the Floor Timbers, Dead Wood, and Tranſoms may be firmly bolted, the Rudder well hung, and the Breaſt-hooks, and Knee of the Head, if any, may be well ſecured: That the Rabbits cut in the Keel, Stem, and Stern-poſt, be ſuitable both for the Planking, and to anſwer the Faſhion of the Body in every reſpect; that the Stem be made fit to lay the Bow-ſprit in aloft, and to ſecure the Stay of the Main-maſt; that the Scarfing and Over-launching of all the above Parts be duly conſidered; that all the Timbers are carried up with equal Room and Space, that one Part of the Ship may have exactly as much Timber as the other, and not to continue them joined in one Place, and ſix Inches aſunder in in other Places; but that after the Frame Timbers are fixed in their proper Places, and truly ſet, they may be parted without Prejudice, and equally ſpaced as the Ship is planked; that there are no Side-round Timbers, but exactly ſtrait, except for the Conveniency of putting them clear of the Ports, which is a very material Point, and ſhould carefully be obſerved, otherwiſe you may be obliged to cut ſeveral good Top-timbers to make Port-holes, and put ſhort Stumps in their Room.

Let your long Timbers be ordered forward after ſuch a Manner, that they may rake forward one after another, and take up as much Room and Space at the Head as at Foot. Alſo turn or cant them forward, as much as poſſible, to ſave the bevelling of the Timber, and that the Hawſe Pieces may have Room to have a ſufficient Scarp downwards. Obſerve carefully, that the Bows of the Ship are exactly equal and ſimilar, and that the Harpings are equal, that the foremoſt Timbers ſtand at an exact Diſtance, both from the middle Line, and from the Stem, which will cauſe the natural Tendency of the Ship to be direct, and conſequently increaſe Motion.

Let the Beams, Pillar on the Fore-riders, and proper Hatchways be made, which are neceſſary for lading and unlading.

The Well is always near the Main-maſt, and ſo are the Pumps; but if they are Chain-pumps, they muſt clear of the Main-ſtep, and have Room ſufficient for reeving the Pump-chain. In a Man of War, the Rooms for the Powder, the Gunner's, Boatſwain's, and Carpeter's Stores are made forward, and extraordinary Care taken, that the Powder-room may be entire, double lined, and well plaiſtered with Mortar between; and a due Conſideration had to the Quantity and Quality of each Officer's Stores; and that they may have neceſſary Diviſions, or Apartments: That the Orlops and Platforms are of ſuitable Lengths and Breadths for coiling the Cables on, partly afore, and partly abaft the Main-maſt; that there are Rooms quite abaft for the Bread, and next to the Bread-room, a Room for Oatmeal, Fiſh, Butter, and Cheeſe. A Steward's Room, Captai Store-room, a ſmall Powder-room, the Purſer's and the Surgeon's Cabi and a Cockpit for the Conveniency of the Men's taking their Proviſio from the Purſer's Steward, and alſo a ſmall Slop-room. But in Mercha Ships, the Hold, or all below the lower Deck, is reſerved for ſtowing t ſeveral Commodities according to the Voyage.

Upon the lower Gun-deck in Men of War, there is an Apartment f the Gunner, for fitting and ſecuring all his ſmall Stores, called the Gu room. Forward there is what is called the Manger; its Uſe to receive t Water ſhipped at the Hawſe-holes, and prevent its running into the Shi All Men of War above a ſixth Rate have both theſe; but there are oft other Apartments, which being various, and differently placed, accordi to the Pleaſure of the Commander, and Magnitude of the Ship, it unneceſſary to give any farther Account of them.

It ought always carefully to be obſerved, in ſpacing the Beams of eac Deck, that the Knees of each Beam be placed clear of the Ports, that the may be no Occaſion for uſing Dagger-knees, or thoſe which are crooke as they are neither ſo ſtrong, nor ſo eaſily purchaſed, as thoſe which a ſtrait. On the middle Deck, in Ships that have three Decks, the Furnac are placed; but in thoſe which have only two, they are placed in t Forecaſtle.

The Bulk-heads ſhould be fitted in ſuch a Manner, that they may b ſecure for a cloſe Fight, and at the ſame Time not embarraſs or hind the Men in ſecuring the Maſts, or traverſing the Yards; but that ever Rope requiſite for hauling or handling the Sails or Rigging, may be readil come at, ſecured, and faſtened.

A due Conſideration is alſo requiſite in placing the Blocks for the Ma and Fore-ſheets, and alſo for tacking the Clews of the Sails, and Block for the Clew-lines, Bunt-lines, Leech-lines, Hallyards, Bow-lines, an Braces, and, in ſhort, every other Rope requiſite in managing the Ship to bring all the Purchaſes clear of one another, and that the Angles o Purchaſe may be as obtuſe as poſſible, for the Facility of moving t Reſiſtant with a ſmaller Force: Channels ſhould alſo be fixed withou Board, of ſufficient Strength, and well ſecured by Spurs, or Knees, th they may be able to reſiſt the Power of the Wind on the Maſts, Sails, an Rigging. To the Channel-wales are fixed Plates of Iron, called Chai plates, and Dead-eyes, bound by thoſe Plates; through the Dead-ey the Lanyards of the Shrouds are reeved, which are ſpread by the Cha nels. Theſe Shrouds, and the Stays, are the Ground-tackling, the gra Security of the Maſts, and therefore ought as near as poſſible to be plac

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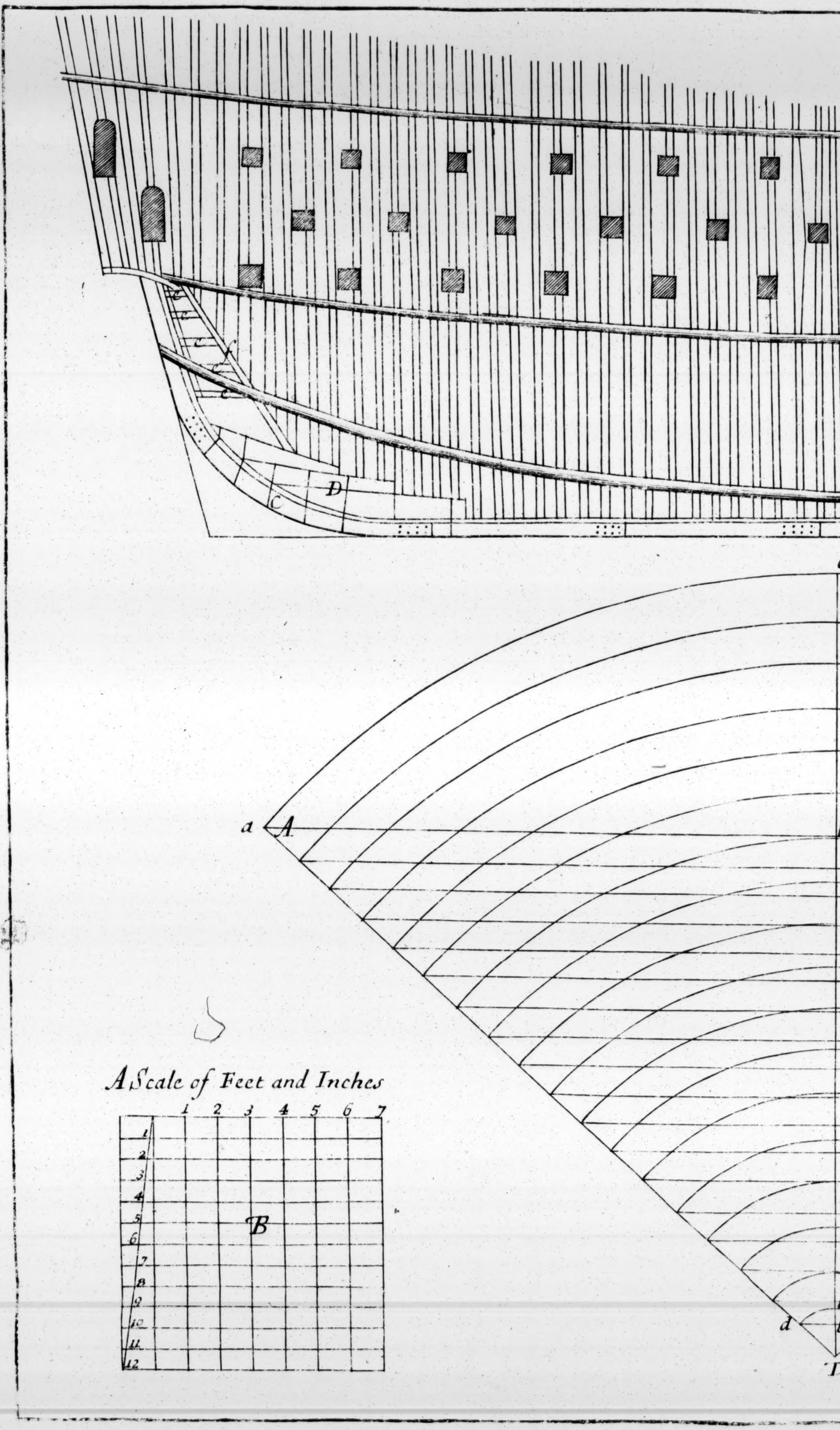
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A Scale of Feet and Inches
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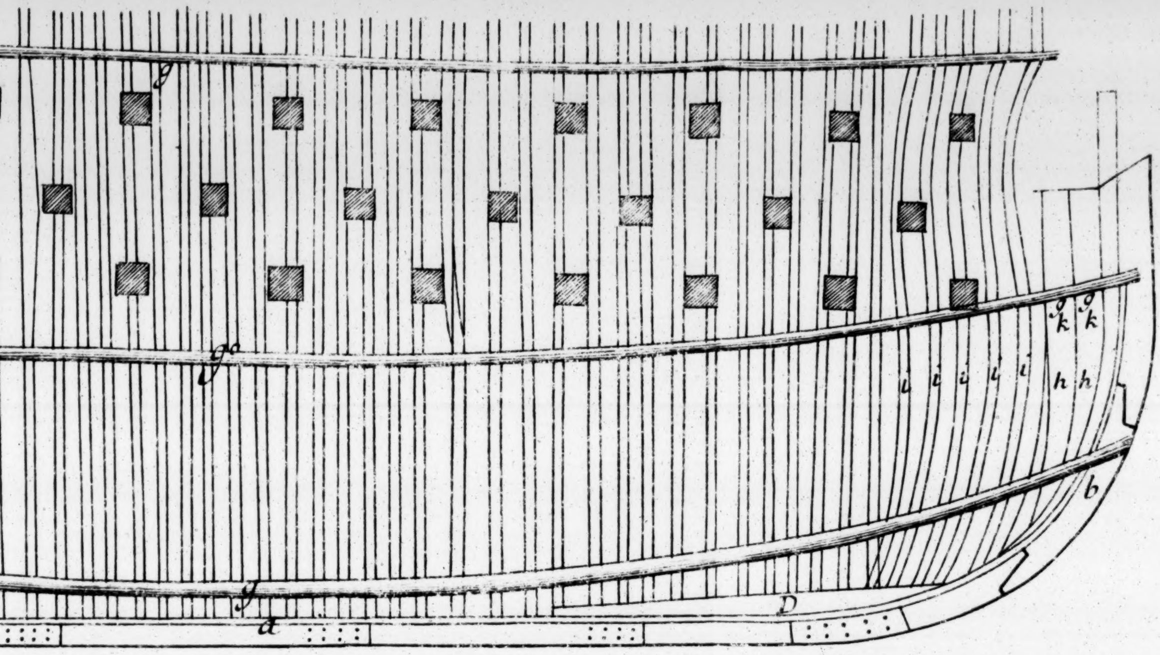
Fig. A.

Plate IV. Facing Page. 82.



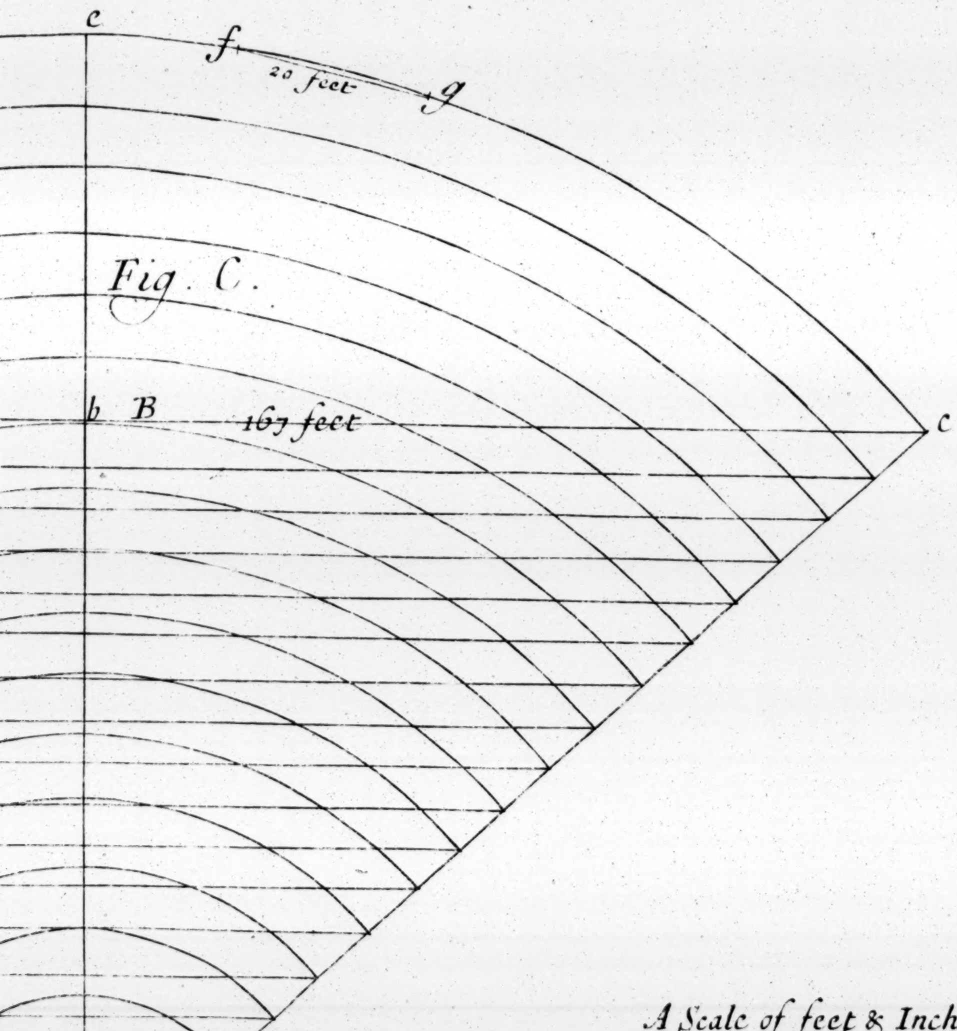
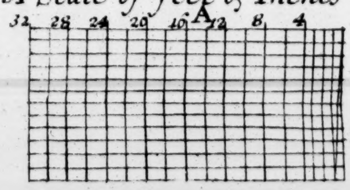


Fig. C.

A Scale of feet & Inches



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circular Poſition, that they may be equally affected by the Strain. Back
s are to be faſtened down to the Channels, or to Stools fixed for that
poſe.

Care muſt be taken to have Conveniencies for hoiſting in the Guns,
viſions, Boats, Anchors, &c. to have Bolts to hook the Gun-tackles
and Breeching, with an Eye-bolt to every Gun, for laſhing up the Muzzle;
have Stopper-bolts for the Cables, and Bolts for laſhing the Boats on the
per Deck; to have Bolts for the Top tackles, Stand-ports of the Sheets,
l Shank-painter Chains; to have Ranges, Kevels, and whatever elſe is re-
ſite of that Kind, for the more eaſily and handily ſecuring and faſtening
reſpective Ropes belonging to every Sail and Utenſil neceſſary and con-
nient for working and ordering the Ship.

As it is abſolutely impoſſible to ſhew the whole Contrivance of ſuch a
ble Structure as a Ship, and the various Parts requiſite at one view on a
ane, we have divided it into ſeveral. *Plate* 4. *Fig.* A is a Section of a
ip, having three Decks, or Platforms for Guns, and only ſhews her
ame, containing the Keel *a*, Stem *b*, Stern-poſt *c*, Dead-wood D, Tran-
ms *e*, Faſhion-pieces *f*, Hawſe-pieces *h*, and the Floor, Foot-hooks, and
op-timbers; which Timbers ought firſt to be equally ſpaced, as repre-
nted in the Figure. By ſpacing is meant, that, in Proportion to the
agnitude of the Ship, there be an Allowance made for two of the firſt
oor-timbers, beſides a Vacancy between them for the Air. Formerly,
deed, it was the Method to put the Ground-timbers, *viz.* the Floor and
ower Foot hooks cloſe together; but Experience having diſcovered, that
is cauſed Putrefaction, and was alſo prejudicial in over-ſcantling the Ships,
was left off.

But what is moſt Material, and ought chiefly to be minded in placing the
pper Foot-hooks and Top-timbers, is to put them clear of the Port-
oles, to ſpace the long Timbers *i*, forward equally, to make Room for
e Hawſe-pieces, which ought to be well ſcarfed downwards, for Strength
the Bows. By ſcarfing is here meant to have a ſufficient Length of Tim-
r below the Center of the Hawſe-hole *k*, or Center of the Strain; but in
neral ſcarfing is uſed for ſplicing, or faſtening one Piece to another.

Let the Top timbers be placed as near as poſſible to make the Sides of
e Ports, that the laſhing Bolts for the Guns may be drove through the
rincipal Timber, and that they may give Scarf to the Port-holes; which
ay be done by marking the Port-holes on the Breadth Ribbands *g*, *g*,
fore the Ship is planked. And if it be found that the Timbers exact
lace be in the Wake of the Port-holes, and that there be not Room ſuf-
ient for placing them otherwiſe, a crooked, or Side-round Timber, that
ll caſt itſelf clear, ſhould be uſed; for all Timbers are placed exactly
rpendicular to the Keel.

Plate 5. *Fig*. B, is a Section, repreſenting the Contrivance of cutting the Port-holes, and placing the Beams, the former of which are marked *u*, and the latter *x*, in the Figure. The hanging Knees are placed in the ſame Poſition with the Timbers, being bolted both to the Beams and Timbers, for holding the Beams to the Sides. The Beams ought to be placed one between, and one under the Ports of each Deck, with this Caution, that the hanging Knee may be placed clear of the Ports, and the lodging Knees abaft the Beams, forward, and afore the Beams abaft, for the Benefit of making theſe Knees as much greater than a Square, or as obtuſe an Angle as poſſible, for the eaſineſs of procuring them. Beſides, in not regarding the exact ſpacing of the Ports and Beams, another Inconveniency happens, which is to have Dagger-Knees.

The Beams ought to lie as near as poſſible under the Ports, to ſupport the Recoil of the Guns when fired, and alſo to lie one exactly over another, that they may ſupport each other with Pillars placed perpendicular; the lower Beams are ſupported by the Bottom of the Ship, and that by the Water.

Another Caution ought to be in placing the Beams clear of the Maſt's Places and Hatch-ways; in order thereto the Main Hatch, which is the principal, ought to be as near the Middle of the Ship as poſſible; and alſo that the Place of the Main-Maſt *c* be near the Hatch-way; the other Hatch-ways are always made according to the Uſe the Ship is deſigned for. But the Maſt's Places and Main Hatch-way are general, and founded on a Cuſtom, that from the Length of the Ship the Diſtance is ſet off from the Stem for each Maſt's Place; this is for a Three Maſt Ship. All other Ships or Veſſels have the Centers of the Maſts aſſigned; but all proceeds from Cuſtom, or Fancy of the Manager, as alſo Hatch-ways, that the Lading and Unlading of the Ship may be performed with as much Facility as poſſible, both to the Eaſe of Men, and Wear of the Ship.

g, are Riders placed to ſcarf the the Floor and lower Foot-hooks, and called Floor-riders. They are of great Uſe in Grounding, eſpecially when they have croſs Pillars ſet upon them. There are alſo lower Foot-hooks Riders to ſcarf the Floor-timbers, and ſecond Foot hooks. For 'tis certain, if a Ship could be built with one Piece, ſhe would be much ſtronger than to have a great many Pieces, ſince at the Head and Feet of each Tire of Timbers, half is cut off.

i, Breaſt-kooks placed in the Breaſt, or foremoſt Part of the Ship, to hook or tie the two Sides of the Ship together.

K, is a Piece of Compaſs Timber, propoſed to ſcarf the Keel and the Stern-poſt together, in the lieu of tenanting the Poſt into the Keel.

a, are lower Wales, which ought to be placed after ſuch a Manner, as to bind, ſtrengthen, and be bolted through moſt of the Gun-Deck Knees. For ſince the Breadth of any Ship is conſidered as the Place of the greateſt Strain, being that Part which makes a Diviſion of the Wind and Water; as the Impulſe of Wind forces againſt the Sails, ſo the Water on the other Hand ſupports the Ship, and keeps her as much as poſſible in her natural Poſition.

The Wales ſhape the Ship, making her look regularly curving and lively, and ought to be ſcarfed clear of the Scarfs of the Clamps within board.

b, are Channel-wales lying in the Midſhips, to make the lower Ports upper Part. The Channels for the Shrouds are placed upon the uppermoſt of the Channel-wales, and the Chain-bolts are drove through the lower one.

P, is the Poop, and *Q*, the Forecaſtle. *O*, the Quarter-deck. *M*, the upper Gun-deck. *N*, the Middle, and *L*, the lower Gun-deck. There is another Plan under that, which is the Orlop or Platform.

e, are Bit-pins, on which the Cables are faſtened. *R*, the Bow-ſprit, or a Security for the other Maſts, *p*, the Chain-pumps leading to the Well, into which the Limbers drain.

Plate 5. *Fig*. G, is a Plan of the Orlop, on which are placed the Store-Rooms, Cables, and ſeveral Officers Cabins; which Plan divides the Hold into two Parts, for the Conveniency of keeping dry Goods from wet. *a*, is the main Hatchway; *b*, the Center of the Main-Maſt; *c*, the after Hatch-way; *D*, the Flag Officers Store-Room; *e*, the Captain's Store-Room; *f*, the Surgeon's Cabin; *g*, the Center of the Mizen-Maſt; *h*, the Steward's-Room Scuttle; *i*, the Fiſh-Room Hatch; *K*, the Steward's-Room; *l*, the Purſer's Cabin; *m*, a Slop-Room; *n*, the Surgeon's Mate's Cabin; *o*, the Bread-Room; *P*, the Sail-Room; *Q*, the Boatſwain's Store-Room; *S*, the Gunner's Store Room; *r*, and 5 Apartments for Powder, to fill into Cartridges, and to ſecure it when filled; *u*, a Powder Trough to empty the Powder out of the Barrels, in order to fill the Cartridges. It will be very requiſite to have the Filling-Room as low as the Ship will poſſibly bear it, and to have it half in the lower Powder Room, and half in the Store-Room, as may be ſeen in *Fig*. B. *S*, which is that Apartment. *z*, *y*, and 6, are Lanthorns fixed after ſuch a Manner, that the Candles may be placed in any of them, without coming into the Store-Rooms, which is extremely convenient, eſpecially in Powder-Rooms, as has been woefully experienced. *w*, is the Carpenter's Store-Room; 1, the Fore Hatch-way. 3's, are Cabins fitted by the Side, for Lodgings for the Quarter-Maſters, and their Mates, *&c.* Though in Time of Engagement the Sides in the Wake of thoſe Cabins are kept clear, for the Conveniency of the Carpenter's finding where the Shot is drove in under Water, that they may come to ſtop the Leaks.

There are ſeveral other Conveniencies for Stowage in this Plan; as Hawſers for the Shrouds, Cables, Pitch, Tar, Anchor-ſtocks, Planks, ſmall Maſts and Yards, Spars, Platforms for the Surgeon's Uſe in dreſſing wounded Men, and ſeveral other Uſes, which being ſo various, cannot be well ſpecified in the Plane, but are univerſally beneficial for ſtowing up Lumber, that could not ſo well be laid up in other Places.

Plate 5. *Fig.* D, is a Plan of the lower Gun-deck, conſiſting of Beams, Carlings, Ledges, Knees, Partners, Capſtans, Croſs-pieces, and Bits, &c. *l*, Beams; *m*, Knees, as Arms to hold the Beams and Sides together; *n*, Carlings; *o*, Ledges; and the Bounding of the Plane repreſents the Ship's Sides. It has been obſervable in laying Floors in Houſes, or great Fabrics, that it is good Management to divide the Floors into Girders and Giſe, that in Caſe a Floor was propoſed to be laid of 4 Inches thick, being divided into Giſe of double Thickneſs, and to lie at quadruple Diſtance, the Strength would be equal, and but half that Stuff uſed; and one Girder of 16 Inches ſquare would be almoſt equal in Strength to 17 Giſe of 8 Inches broad, and 4 Inches thick; which Girder contains but half the Stuff of the 17 Giſe. But however this is in Houſe Work, where the Caſe is quite different, from the extraordinary Strain, and other Circumſtances, which ought to be thoroughly weighed in joining and uniting the Parts of a Ship: For here the Beams are conſidered as the principal Members that hold the Sides of the Ships together, againſt ſuch a rapid Motion, which ſometimes happens by the extreme Force of Wind, and Violence of the Sea. And the Beams are held with Knees, firmly bolted and clinched, the Weights of Guns carried in ſuch a Ship on the lower Deck being near 80 Tons, beſides the Men and their Conveniencies. However it is one Advantage in Ships, that is not in Houſe-building, that the Decks are well pillar'd, which is a great Stiffening.

There is likewiſe a great Quantity of Timber ſaved, by dividing the Deck into Beams, Carlings and Ledges: For if inſtead of Carlings and Ledges in any Deck, there was to be a double 4 Inch Plank, then a whole Superficies of 4 Inch Plank would be more than 24 Beams of 18 Inches one way, and 16 Inches and a half the other, with ſix Tire of Carlings and Ledges ſuitable for the Work. The Bigneſs of our Shipping has but 4 Inch Plank for the Flat of the lower Gun-deck, which is chiefly deſigned for Caulking, to keep all dry. However this material Conſideration ought to be obſerved in all ſuch Caſes, that the Plank be well ſupported, that

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Plate V.

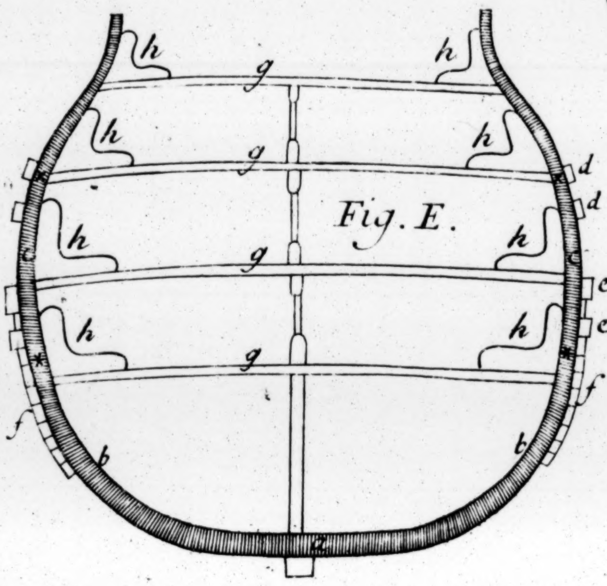


Fig. E.

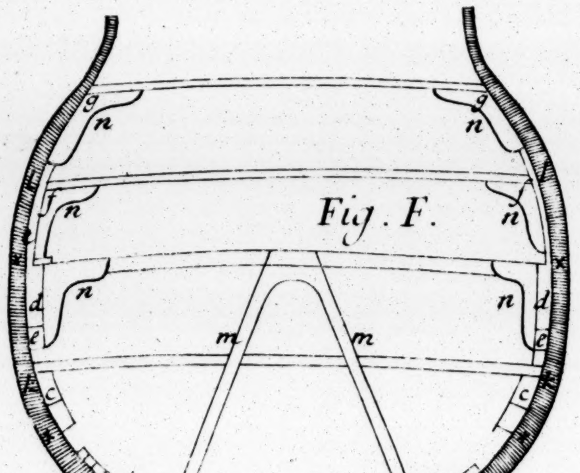
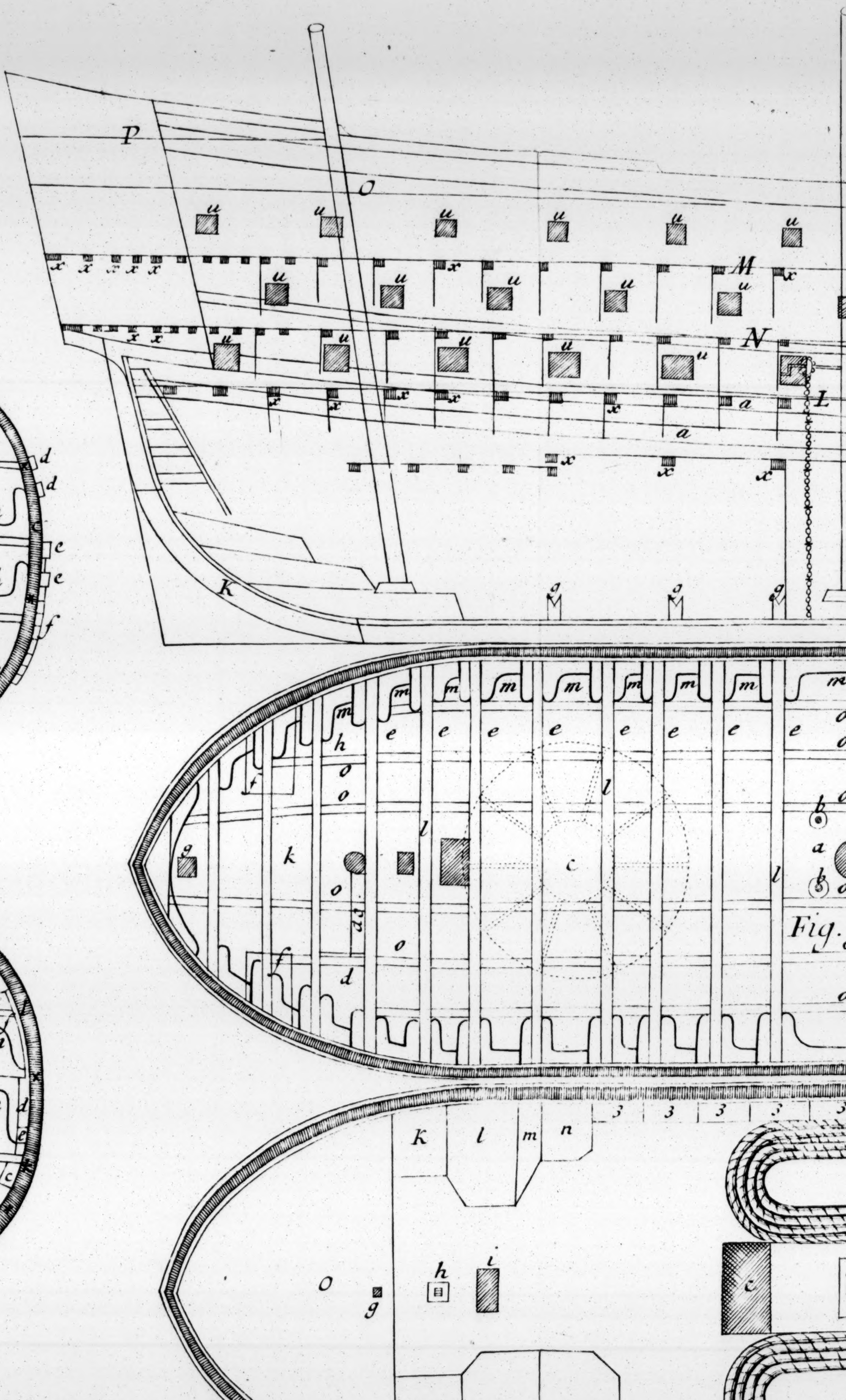


Fig. F.



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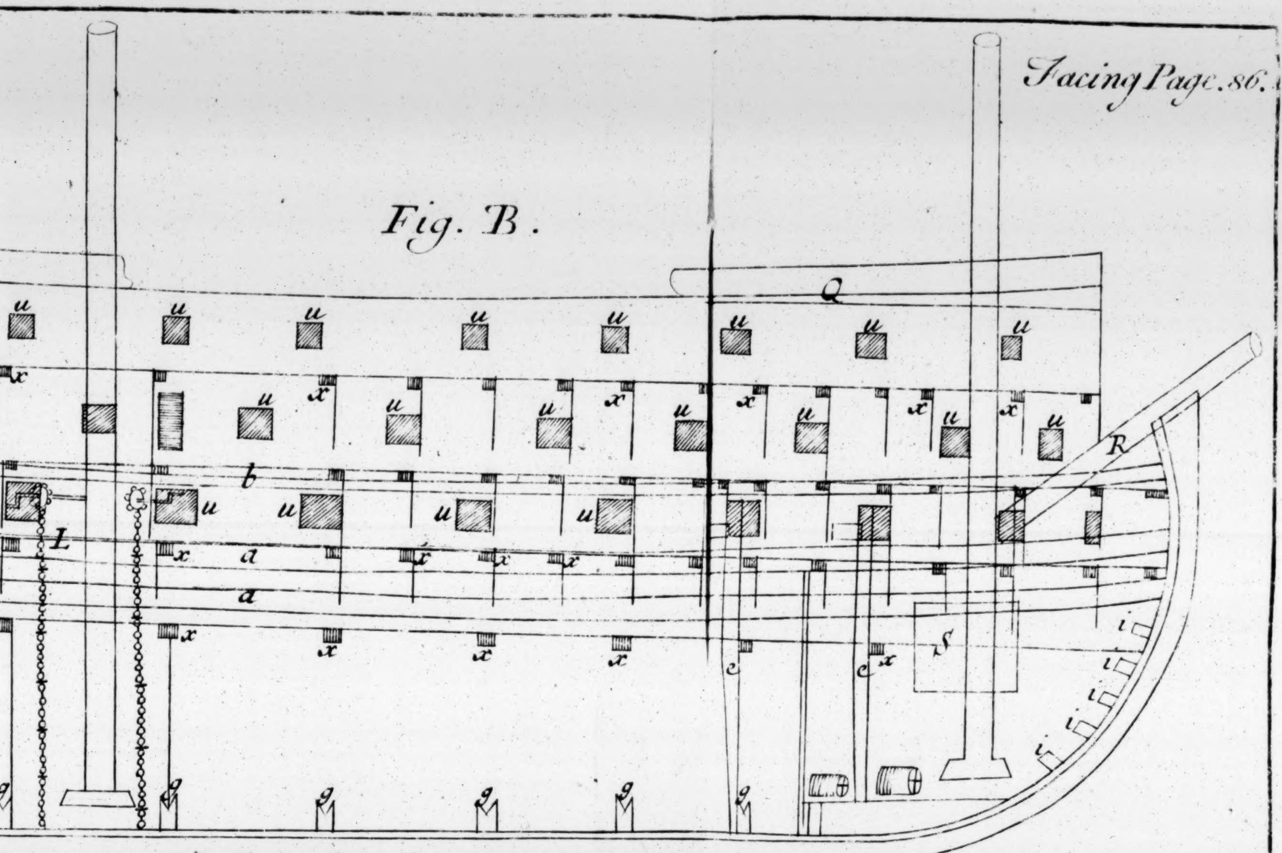
Fig. B.

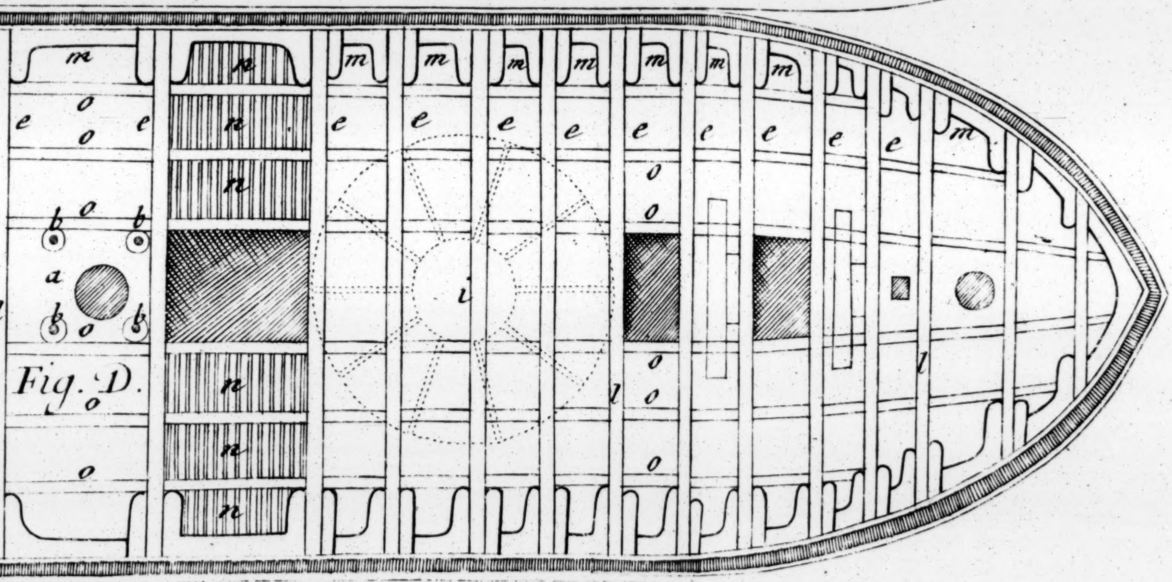
Fig. D.

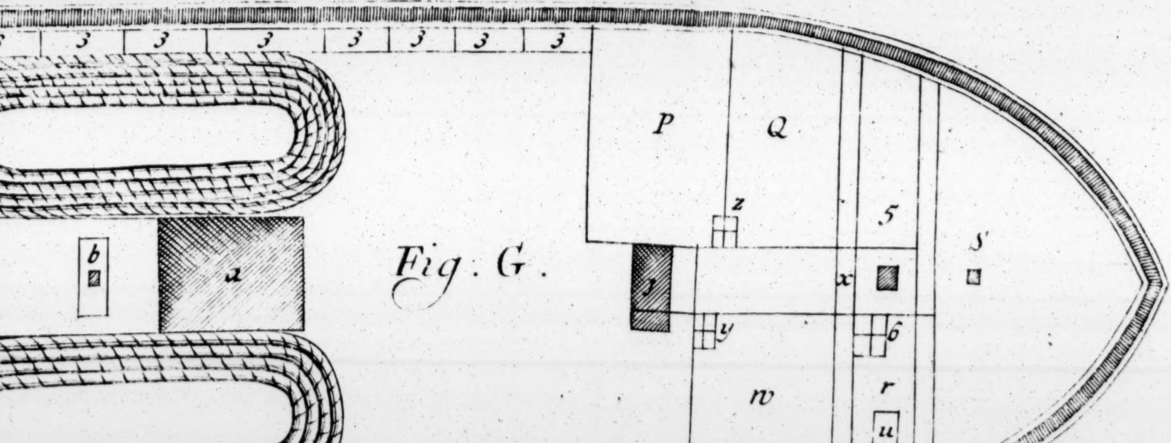
Fig. G.

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extreme Diſtance may not cauſe Drumming, as the Shipwrights term which will not only cauſe Weakneſs where Strength is required, but the Caulking to Drum, which will be neither ſo durable nor ſo dry, if the Work were of ſuitable Strength.

a, is the Partners of the Main-Maſt, where the Pumps *b* are placed; the Jeer Capſtan; *c*, the Main Capſtan; *k*, the Gun-Room; *d*, the nner's Cabin; *a*, a Place for the Gunner's ſmall Stores; *g*, is the Bread-om Scuttle; *f*, the Gunner's Mate's Cabin; *b*, is often a Lieutenant's bin.

There are beſides theſe a Plane of the Middle Deck, wherein the Fur-ces for boiling the Proviſions are placed, and Cabins for Lieutenants, aſter's Mates and Midſhipmen. The Entring Ports are alſo placed here. ne Upper Deck has alſo Cabbins for the Flag Officers, or Commanders, eutenants, Boatſwains, Carpenters, and Mates; beſides neceſſary Con-vances for Rigging. On theſe two Planes you have alſo as many atings as can poſſibly with Convenience be placed for cauſing Lights on Plane below, as alſo to give vent to the Smoke of Powder in Time of rvice. There is a Quarter Deck, Fore Caſtle and Poop, with ſeveral partments for Officers, and Conveniences for managing the ſailing Part. t it muſt be remembered, that all theſe Bulk-heads mentioned being ninencies, are a greet Hindrance to the Motion of the Ship, eſpecially nen ſhe ſails againſt the Wind.

Plate 5. *Fig*. E, is the Bend of the Timber in the Midſhip, and ſuch ends are placed at equal Diſtance, as may be obſerved in *Plate* 3, *Fig*. A. ch a Ship has 100 ſuch Bends, only altering according to the tapering the Ship. *g*, are Beams, and *b* Standards, bolted through the Beams d Sides, and are applied to an old Ship to ſtrengthen her. *a*, the Floor imbers; *b*, ſecond Foot-hooks; *c*, the fourth Foot-hooks; *d*, Channel ales; *e*, Main Wales; *f*, the diminiſhing Strakes to taper the Plank of Bottom from 9 Inches to 4 Inches thick.

Plate 5, *Fig*. F, is a Bend of Timbers to ſhew another Part, where *m* is roſs-pillars, *n*, Knees. The Croſs-pillars are ſtepped on the Floor-riders, d faſtened to the Gun-deck Beams, to ſupport that extraordinary Strain, hich is cauſed by the Ship's moving, and alſo in laying on the Ground. the lower Foot-hooks; *k*, the third Foot-hooks; and *l*, the Top-timbers. which you may obſerve the Timbers to be equally ſcarfed, the Middle one Timber being in the Wake of the Head and Heels of the others. is a Floor-rider; *b*, the Sleepers or thick Strakes at the Floor-heads and cond Foot-hook Heels; *c*, the middle Bands or Orlop Clamps; *e*, the pirkit Riſings, which are placed under the lower Gun-deck Ports; *f*, the middle Deck Clamps; *d*, the lower Deck Clamps; *g*, the upper Deck Clamps; and *h* the Spirkit Riſings under the middle Deck Ports

We obſerve this Method as near as poſſible to lay our Ships Decks one from another either exactly parallel or diminiſhing, according to the Uſes requiſite in ſuch Decks. The Rules for doing the ſame have been always various, according to the Fancy of the Workman; ſome ſetting off the Decks, by ſtretching a Line on the Side, parallel and perpendicular from the other Decks. The lower Gun-deck is ſet off from the Keel, though ſome Work is ſo very exact, that they will ſet off the lower Deck from the Breadth ſur-marks.

But the uſual Method is putting up the Beam Mould at the Heights in the Middle of the Ship, and ſetting off one Height on the Stem, and another at the Stern, and ſtretching a Ram-line from thoſe Heights afore and abaft, till the Line by its own Gravity touch the upper Part of the Beam Mould, obſerving that the Beam Mould be kept to its true Rounding; then ſetting off ſeveral Spots on the Side, by keeping the Beam Mould at the Side, and the Line out of Winding with all the Spots you ſet off After you have made your Spots pretty near one to another, mark out a Red Line for the more eaſy diſtinguiſhing; then level another Line on the other Side of the Ship, from the firſt exactly out of winding, or parallel from the other.

But becauſe a Line hanging by its own Gravity cannot be truly circular, but will be rounder in the Middle than at the Extremities; therefore, after the Gun-deck is truly ſet off, either from the ſur-marks, or from the upper Edge of the Keel, it may be proper to ſet off the reſt of the Deck from the lower Plane, by Perpendiculars, and parallel Heights. The ſame may be ſaid of the Wales. The propereſt Method is to ſet off perpendicular Heights from the upper Edge of the Keel.

But the general Miſtake in ſetting off Ships Decks, is the not obſerving to ſhorten the Beams aft and afore, by which Means the Decks in the Midſhips round a great deal more than at the Extremes, cauſing the Decks at the Sides, and in the Middle to be different, by hanging tranſverſly or fore and aft.

CHAP. VIII.

Of PLANKING.

PLANKING is ſo very material a Branch, that unleſs it be well performed, all the other good Properties will be of little Uſe; but by this Term is not barely meant the outſide Planking; but likewiſe all the Clamps, Spirkit riſings, thick Stuff, Wales, and Channel Wales without Board: This ought to be well performed, by joining, faſtening, caulking, and the Goodneſs of every Inch of thoſe Materials carefully inſpected. The Scarfings, or Over-launchings of the Planks, ſhould be placed alternately, that the Ship may be equally ſtrong, and that one Part of her may not be more cut or mangled than another. And in order to this the uſual Way in Planking a Ship's Bottom, is to leave out the Garboard Strake, or that next to the Keel; but that Strake not being eaſily ſhut in, the next is to be left out, for the Conveniency of clearing the Hold of Chips or Dirt, till the Ship is built. In ſhifting the Butts you muſt be careful to put them clear of the Scarfs of the Keel, and that a Butt may not be put in the Wake of the Pumps, as it may be of dangerous Conſequence, either in ſtraining the Butt, or ſucking the Oakum out of the Seam.

Regard muſt alſo be had to the Lengths and Breadths of the Plank you intend to uſe, that the Rabbit of the Keel, Stem, and Stern-poſt may be made exactly to fit your Plank. The Length of the Plank you have to work, is chiefly to be obſerved; for if you cannot continue working up to the lower Wale, with the ſame Lengths you begin with, you will certainly be at a Loſs, and have worſe Work upwards in Sight, than you have lower down.

The Breadths ought to be conſidered, and alſo the Faſhion of the Plank: For if you deſign to bring every Strake of Plank to the Stern, you muſt obſerve the Shape of the Ship's Body, ſince it will be very difficult to do it in ſome Ships that have large Floors and full Bows. It is therefore very cuſtomary in many Ships to drop or ſteal, as they term it, ſome Strakes ſhort of the Stern, and raiſe what you can regularly in the Bulge and Loof. You will likewiſe be obliged to have ſnying (or crooked) Planks to continue the Cuſtom generally practiſed. However, let the Cuſtom be as it will, as much as poſſible keep your Work from extreme Snying or Cambering.

The after Part of the Ship ought alſo to be minded, where the Ship's Body is a hanging Conoid, and the Tangent-line perfectly ſtrait, by which means moſt Ships have Hollows ſo long and deep, that you cannot well work the after End of the after Planks too broad, to bring the Plank's Edges ſtrait, that they may lie on a direct Plane, out of Winding.

The beſt and moſt proper Way is (if a Workman could be allowed ſuch a Privilege) to ſee the Faſhion of the Ship's Body, and the different Length on the Girt at every Frame Bend, or third or fourth Timber, from the Keel to the Wale. Then he might make exactly equal Diviſions, and every Plank might be of equal Breadth throughout the whole Work. An expert Workman however thinks it no difficult Matter to birth up a Ship's Bottom exact and genuine. For afterwards it is but to obſerve the true Swing of the Ship's Body, and make the Edges of all the Planks ſtrait, aft and afore, where the Edges are rounding, by regular Curves, according to the Nature of the Ship's Body. Otherwiſe the Ribbands are as good a Guide as need be, being perfectly ſtrait aftward, and will lie no otherwiſe than on a direct Plane, and afore they are rounding according to the Nature of the Ship's Body or Bow. But however, to ſet off the Height of the Wale in divers Places is very proper; for the exact Gauging of the Strakes of Plank, eſpecially upwards, where it is very commendable to ſee Work well, and exactly performed.

It is alſo allowed in Ship-building, that if three whole Planks be wrought between two Butts, from 4 Inch Plank to the thickeſt Stuff, if one Over-launch the next but 6 Feet, it is ſufficiently ſtrong. And according to this Rule it is generally ordered to fall out in the thineſt Plank, tho' a nice Proportion of ſuch Over-launching and Scarfing of Plank will come neareſt to the Cube Root of the Length that each Ship is one to another. And if it is demonſtrable that by ſuch a Method, it will be ſufficiently ſtrong, it would be moſt proper to provide and plank Ships Bottoms according to the Magnitude and Length of each reſpective Ship that is immediately to be planked, ſince the Price of Plank and Timber increaſes or decreaſes according to the Bulk or Uſefulneſs of each Piece.

But if there be a falſe Notion in converting Plank, or if it be meant rough Plank as well as rough Timber, it is very prejudicial and deſtructive to the Manager: For in Plank we conſider here but of two Dimenſions, Length and Breadth, ſince the Thickneſs gives it the Name of Plank, according to the Size it bears; ſo that Plank and thick Stuff for Ship Work may be exactly fitted to their Length and Breadth, though 100 Miles from the Ship they are intended for, ſince ſeven-eighths of all Sorts of Plank for Ship Work is a perfect Parallelopipedon, ſtrait, and of parallel Breadth: And whoever conſiders it otherwiſe, waſtes one-third of ſuch a valuable Commodity as Plank is by falſe Converſion. Indeed afore and abaft the Plank is of another Faſhion, and is termed Snying Afore, and a ſhort Turn of Snying Abaft; but however ſuch Plank may be alſo as exactly provided.

The croſs Marks are the Butt-Ends, which are ſhared with as much Exactneſs as poſſible, that every Part of the Ship may be of equal Strength or Weakneſs, which is cauſed by thoſe Butts Ends, ſince equally to ſhare Butts, and work 3 whole Planks between 2 Butts, is to work all 24 Feet Lengths, and with 30 Feet Lengths 4 may be wrought between, and ſo on, notwithſtanding a Ship will be the ſtronger for having long and broad Planks, provided they are well faſtened and joined, and continued throughout the whole Ship; if not, the Property will undeniably be otherwiſe.

At the Breadth of the Ship under the lower Wale you work 3 or 4 Strakes, diminiſhing in large Shipping, to bring 8 or 9 Inch Stuff to 4 Inch Plank.

The Plank of the Buttock, or aft Part of the Ship, is very difficult to work, by reaſon of a ſudden Round, about the Faſhion-piece; the Plank herefore provided for that Purpoſe ought to be the beſt and choiceſt, ree from Knots, or any other Defects. The Outſide of the Tree, and he Ground-end, is always beſt for that Purpoſe, and ſo for all other Plank that is much bent by Fire.

The principal Regard in planking the upper Works, is to ſhift as clear of the Port-holes as poſſible, that what Weakneſs is cauſed by cutting uch Holes, may be ſtrengthened by the Work that is brought on near hem. The inboard Work is always allowed to contribute moſt towards he ſtrengthening, ſince it is generally thicker Stuff, and well hooked and carfed: And a due Conſideration ought to be had in Planking within-oard, to ſhift the Butts clear of thoſe without-board; to flat ſcarf the oot-wailing, that the Timber may have but two Holes inſtead of four, hich would be required in working common Butts.

You muſt alſo obſerve, that all projecting Parts of ſuch Wales are laid arallel to the Horizon, though that Part which makes the Seam for the akum is in all Work perpendicular to the Timber in the Wake, other-iſe the Caulking would force one Plank's Edge off, and not be good ork.

Plate 4. *Fig*. C, ſhews the Method of ſhaping of any Ship upwards, rmed Sheering of her, the better to accommodate her to the Element e is to act in, when ſo diſturbed by the Violence of the Wind, that its aves reſemble Mountains. It is then very ſuitable to the Nature of h a Machine to be curved, ſince the Body of any Ship under Water is no other than a hanging Conoid, and is not ſupported by her natural Body, near ſo well afore and abaft, as ſhe is in the Midſhips, or largeſt Part of her: From whence the Weight of the Extremes will cauſe an Alteration in the Sheer, as ſoon as ever the Ship is launched, and in the Water; ſo that if a Ship was made perfectly ſtrait, and parallel to the Surface, ſhe would look broken backed, or to ſpeak more technically, Camber keeled.

The Opinion of Men in this Point has been various, both as to the Proportion of hanging in 20 Feet Length, and the Difference in the Height between the foremoſt End, and that abaft, there being an oppoſite Conveniency in the two Properties, though in their Nature they anſwer the ſame Effect.

It is the Opinion of ſeveral, that the quicker the Sheer is, the more it contributes to the Strength of the Ship, and makes more Heights upwards, which accommodates the Ship, as does likewiſe the laying of the Wale higher abaft than afore; ſince the accommodating the principal Officers Cabins is what is aimed at, which are always placed aft. This Property of quick and different laying the Wales will be moſt ſuitable to great Ships, which carry a great many Officers, and ought alſo to be built very ſtrong. But in ſmall light Ships, that are only built for Runners, and where perhaps there are but few Officers that expect great Apartments, the ſtraiter and ſnugger the Sheer lies, the leſs Wind is held to hinder the Motion of the Ship. For undoubtedly every Bulk head, and the Cavities which are oppoſed to the Wind, hinder the Motion of the Ship.

Therefore this Figure cannot at one View be made general, becauſe of the Variety in the curving of Ships. However, it will lead towards a Rule to make all Shipping ſimilar in their Curving, or Bending the Sheer, ſince 'tis an uſual Method, from a Boat of 10 Feet long to a Ship of 170, to give the Hanging either in the whole Length, or in 20, 10, 5, or any Number of Feet in Length; only obſerving that the whole Length of the Ship muſt be taken, from the Chord Lines, as *a b c*; and the hanging or rounding of the Sheer in her Length, from the perpendicular Lines, as *D b e*; and meaſured on different Scales. The Scale *A* meaſures the Length of the Ship, and the Scale *B* the Hanging. But to find the whole Hanging, from the Hanging in 20 Feet, ſquare 20, and ſquare the Length of the Ship on the hanging Line; then ſay, if the Square of 20 gives 1 Inch and a half, or any other Hanging, what will the Hanging or Bending of the whole Length of the Ship be?

A, *B*, *c*, are 169 Feet, the Length of the Ship on the Sheering Line, and *B*, *e*, the Hanging in the whole Length, *f*, *g*, 20 Feet, and hangs 1 Inch and a half: *d*, *b*, *o*, 10 Feet, the Length of the ſhorteſt Boat there is fit for any Service, and *b b*, 4 Inches, or the whole Hanging.

Not that this true circular Sweep can ſo correſpond, as to make an exact Sheering Line, ſince a Ship's Body conſiſts of Elliptic, or ſpiral Lines, terminating at each End in a Point. Whatever then the Lines are, that taper the narrowing of the main Breadth (which is near the Place your Water lies againſt) the Sheering Line ſhould anſwer both to the Length and Bending of the ſame.

Plate 6. *Fig.* F, and G, ſhew the Shape of the Body from the main Breadth upwards; F, being the aftermoſt, and G, the foremoſt Timbers; *b* ſhews the Shape of the Wales, and how thoſe Strakes that project ſhould be managed.

Plate 6. *Fig.* 1, ſhews the winding, twiſting, or wreathing of a Ship's Timbers above Water, which is cauſed by accommodating the after Part of the Ship. And forward it's to make Proviſion to keep the Anchor from the Bow, when purchaſed by the Cat-Tackle.

Fig. 2. is the Shape of the Channel-wale at one Beveling or aft Part of the Ship, where the Timbers are near upwright or level; *Fig.* 3, the Shape at the next Beveling; *Fig.* 4, the next; *Fig.* 5, the next; *Fig.* 6, the next. And after a Piece of Timber is cut to its Thickneſs and Depth, there is always left ſome Wood to work on; no Sawyer being able to work ſo true as a Shipwright can with an Adze. The Piece is cut in the Faſhion of a Parallelopipedon, and trimmed after that manner, and the Lengths of the Pieces ſet off on the Ship's Side. In the Length, 3, 4, or 5 Sur-marks are made, according to the Length of the Piece, and at every Sur-mark the Beveling (or Declination from a Perpendicular) is taken with a Level Bevel, as *Fig.* 4, having one Limb perpendicular to the other, as 14 and 15. The other Limb 6, being ſo to move, that by keeping 16 on the Side of the Timber, and 15 parallel to the Horizon, and the Plummet in 14, perpendicular to 15, then 6 gives the Declination of the Plane. When the Bevelings are taken, you mark them off on a Wedge, or Piece of Batting for your Purpoſe, till you come to ſet them off on the Piece you are to work; which Bevelings are ſet off from the Inſide of the Piece, as in the *Fig.* 6. 10, 5, 7. And keeping the Stock of the Bevel 15, to the Inſide, the Tongue 16 being fitted to the Beveling will mark out 6, 8, which will cauſe the projecting Part of ſuch Wales to be out of Winding throughout the whole Work. This is termed Bearding the Channel-wales; firſt obſerving that your Pieces are exactly of a Thickneſs, and the Bearding projected from the exact Thickneſs of the Plank you deſign to work in the Wake of ſuch Wales, then ſet off the Depths from 7 to 10; and ſquare over from 10 to 9. Which Method will make the Piece exactly of a Breadth on the Beveling, or Declination of the Side. If the Ship-ſide declines much from a Perpendicular, this Method will not look well to the Eye, provided your Sight is level from the Object, or Channel-wale. Therefore to make ſuch Wales of equal perpendicular Heights, you muſt proceed as in the *Figure* 7, by making Uſe of ſuch a Square as 8, 9, placing one Limb on the Bearding 1, 2, and ſetting off the exact Depth you deſign the Piece to be. On the other Leg, the Point 4, will mark out the Breadth, or more properly the Depth of the Pieces fore and aft the Ship. Then you may either make the lower Part of the Wale parallel to 1, 2, which will be the Level as 6, 4, or parallel to 2, 3, which will be Square. But the lower Part is commonly ſet off between a Level and a Square, in ſuch a Method, as the Line 4, 5. But ſuch a Method will require more Waſte, or Wood to work on, if the Declination of the Ship's Side be conſiderable.

There is yet one Obſervation worthy of Notice in working the Channel-wales, which are crooked, called Harpings, and Following Pieces to the Harping; ſince ſuch Pieces ought to hang neither more or leſs in their Length, on a direct Line fore and aft the Ship, than the Midſhip Pieces. But ſuch a Bending cannot be ſo well marked on them, by ſpringing a Line by its Elaſticity; for ſo large a Spring cannot poſſibly fall exactly true. It will therefore be more proper to put ſuch a Piece into a Poſition, that it may, after it is pointed with a Plummet, be altered from that Poſition, into ſuch a one, that, when the Sides of the Piece are made Perpendicular, will either hang or be crooked to what you deſign: Which is done only by canting the Piece, as 'tis called, backward and forward, according to the Hanging and Bending deſign to give.

Theſe following Pieces or Harpings commonly wind or twiſt two Ways, as may be obſerved by the Lines 1, 2, 3, 4, 5, 6, 7, (*Plate* 7. *Fig*. 4.) 4, being perpendicular to the Horizon, and the other declining from the Horizon, or Perpendicular two Ways in ſuch Caſes you muſt have two Bevels, putting one Part, as the Stock, parallel to the Horizon, and the other Stock of the other Bevel always perpendicular to that.

The *Figure* ſhews the Nature of ſuch Bevelings in the Wake of any following Pieces; 4, being perpendicular, and where the firſt Bevel Spot ought to be taken; 1, 2, 3, being Bevel Spots afore the Middle of the Piece; and 5, 6, 7, abaft that Spot. Therefore to put this Piece out of Winding, is to make the upper Edge according to the Line *a*, *b*, to do which is to keep the Limb of your level Bevel 15, in *Plate* 6. *Fig*. 3, always exactly in the Line, *a*, *b*, *Fig*. 4. *Plate* 7.

There is ſtill another nice Point to be conſidered in the Harping, which is always round, as well as the following Pieces; and altho' Wales, yet

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Plate VI.

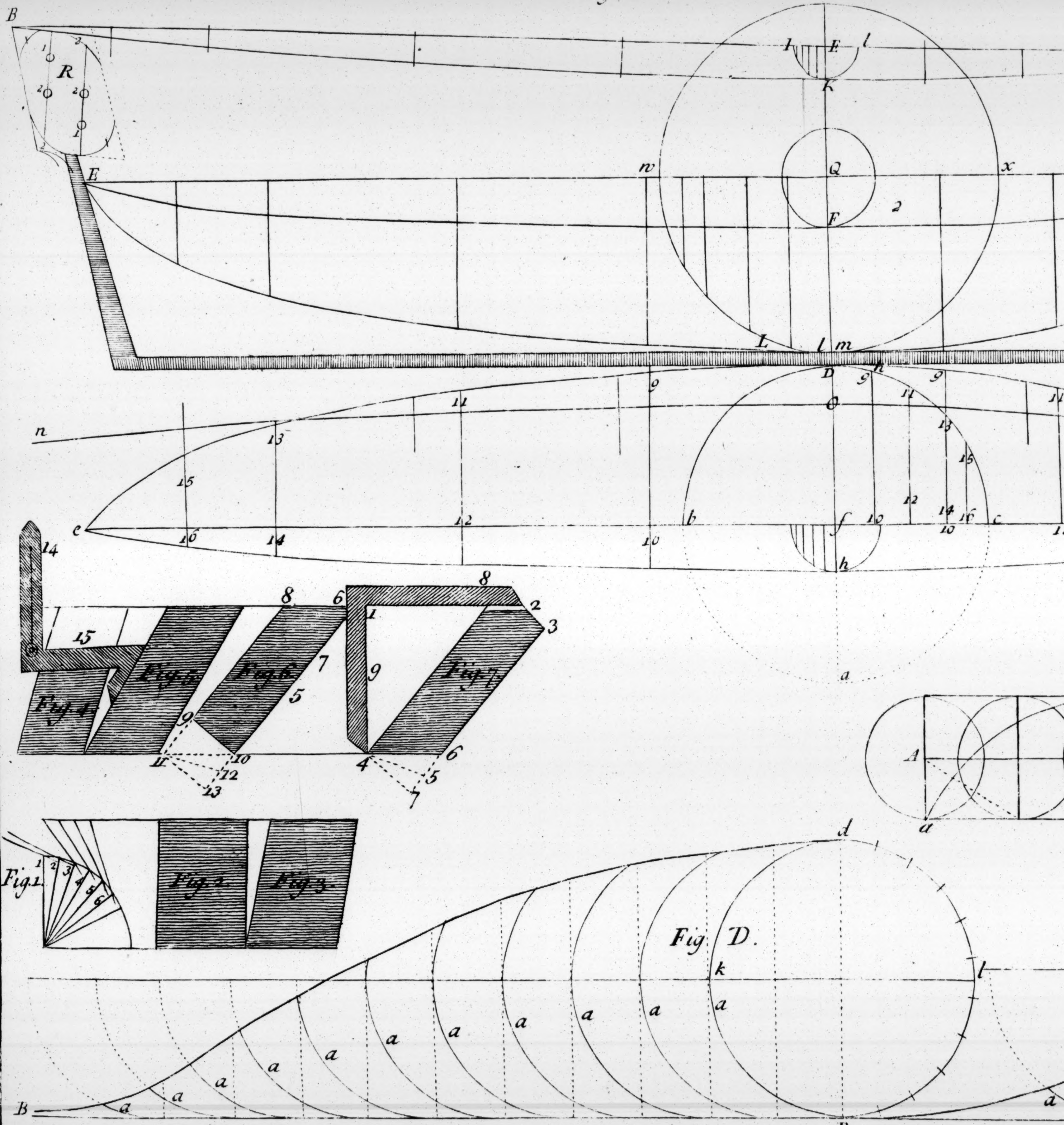
Fig. A.
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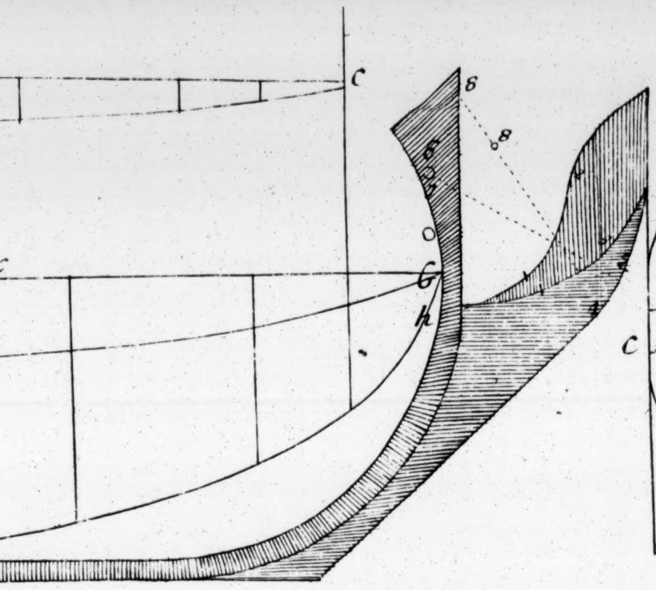


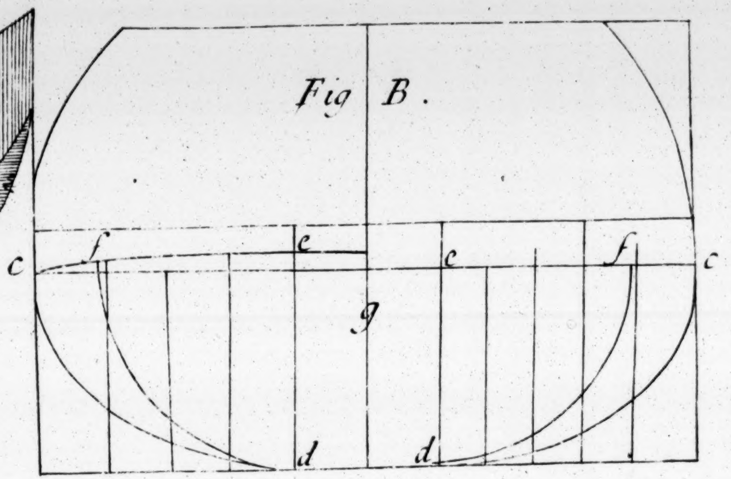
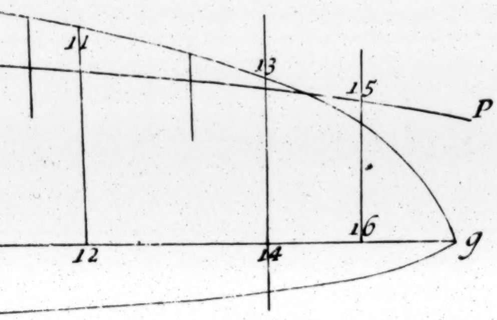


Fig B.



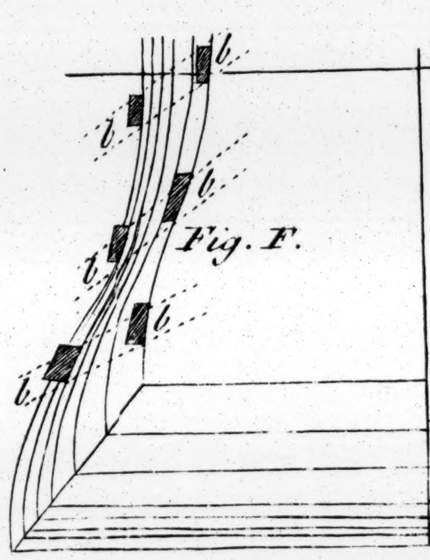


Fig. F.

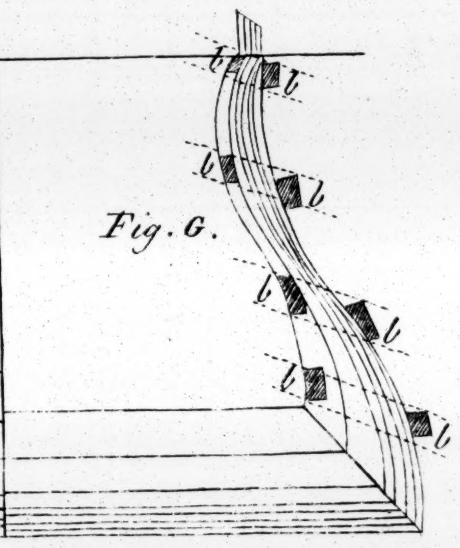
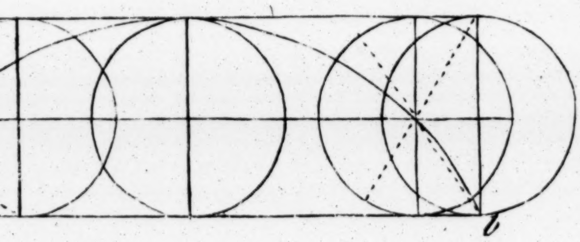


Fig. G.



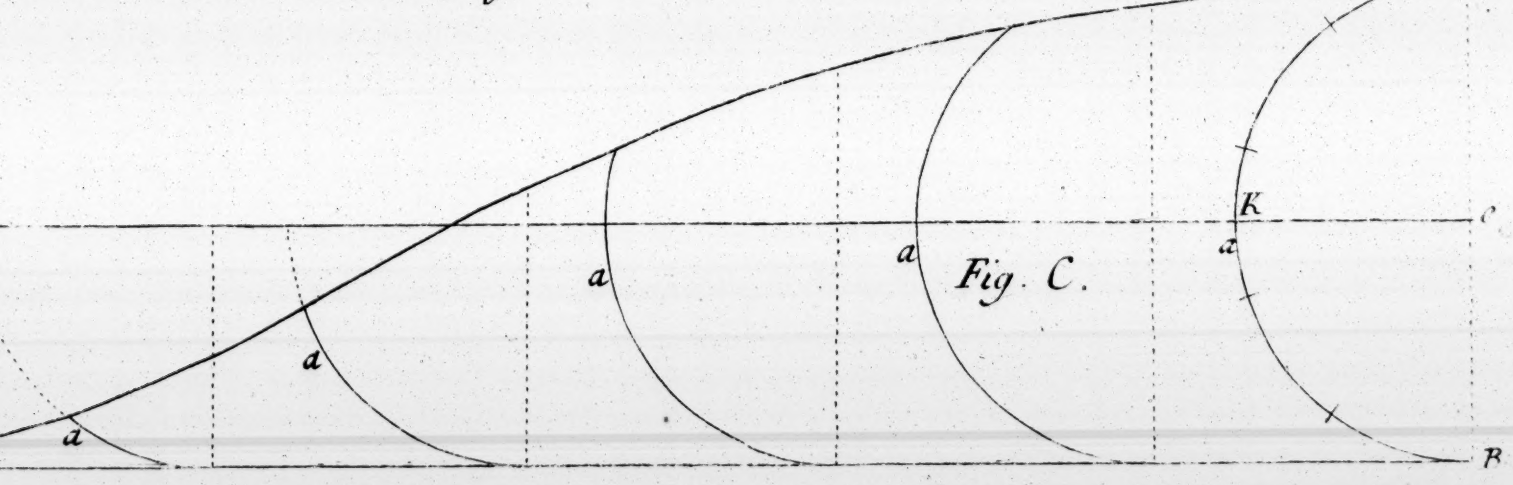


Fig. C.

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hey may be bent by Fire, provided there are not Pieces at hand, which re as circular as are requiſite. But the difficulty conſiſts in taking the Bevelling; for if the Ship is placed much by the Stern, there muſt be an Allowance for that Declination of the Ship, in taking the Bevelling of the oremoſt Part of the Harping.

All Plank ought as much as poſſible to lie on a direct Plane; for in any ther Poſition, the danger in bending or twiſting of them to their Work, will be greater than if they rounded on a direct regular Plane, in proportion to ſuch an irregular Twiſt.

In working up a round Buttock of a Ship, the lower Edge of the Planks will have a ſudden Sny aft, tho' the upper Edges are always lined ſtrait. o that the Planks under the Nuckle Timbers forward, and perhaps the fter Ends of ſuch Planks as the Buttock; and tho' foremoſt Ends of the thers (according to the Faſhion of the Ship) are 16 or 18 Inches broad, nd the other Ends not above twelve.

All Planks under the Wale ought to lie upon direct Planes, as ſoon as hey can be brought to ſuch a Poſition, and above the Wales you are to work the Breadths of all Plank by Perpendiculars and parallel Heights.

Snying is obſerved to make the working of Ships Bows very difficult, nd the Plank to perform the ſame very chargeable to be purchaſed. ince all the plank, which births up any Ship's Bow, muſt be converted rom principal Compaſs Timber. For tho' Plank may be eaſily bent flatways, yet take what Method you pleaſe, it cannot be near ſo well bent Edge-ways, becauſe of the great Diſproportion between the Breadth and Thickneſs. In ſuch Bows therefore there muſt be wrought large principal Timber, if you work according to the common Method of bringing every oremoſt Hooding End to the Rabbit of the Stem.

CHAP. IX.

Of BEAUTY.

THIS Branch teaches to deck or adorn a Ship, or ſuch like Machine, with that Symmetry of Parts, as to render it agreeable to every Spectator; but with this Proviſo, that the Beautifying may be no Detriment to the other good Properties.

And here a very delightful Scheme preſents itſelf, if we conſider the admirable Contrivance of Nature in the Production of Natural Bodies, formed after the moſt exact and accurate manner. From whence Obſervations may be made for laying down Rules uſeful both in this and other Arts. But it may not be amiſs further to take notice here, that there is a vaſt Difference between Bodies wholly immerſed, as Fiſh, and thoſe which carry their Bodies in two Elements, as ſome Fowls. Wherefore before the true and exact Shape of a Ship be fixed on, the Proportion ought to be truly conſidered; which cannot be better determined than from obſerving out of the vaſt Number of Ships that are in the World, which are the eaſieſt and pleaſanteſt in the Wear, and have likewiſe all other good Properties. Theſe are the Ships from whence the Lengths, Breadths, and Depths of all Shipping ſhould be derived. But as to the Shape, it ought to be taken from Art and Nature, and drawn from a Globe. Not that any Ship can be thought regular, or rather convenient, perfectly globular; then ſhe would not anſwer the Deſign of ſuch a Machine, but move always that way which the Wind forced her, or directly from the Wind's Eye; for it is very obſervable, that although the Wind has a great Power over any Ship, as long as ſhe is at reſt, and before any Sail is ſet or ſpread upon her; yet when her Sail is managed and trim'd to it, ſhe will, by traverſing, ſail directly to Windward, which could not be, were her Length and Breadth equal; for then ſhe ſhould move with the ſame Facility Sideways, as End-ways, and go directly with the Impulſe of Wind. However, a Ship may, and indeed ought to be formed as near a globular Figur as can poſſibly be allowed, with reſpect to the other Conveniences tha will be requiſite in managing of her.

Plate 6. *Fig*. A, ſhews that *a*,*b*,*c*, *D*, is the Circumference of a Globe' Superficies, and *e*, *f*, *g*, *b*, a Plane drawn in Proportion, as 4 to 1; tho all Ships do not bear ſuch a Proportion, but perhaps ſome more, and ſom leſs. However, ſuch a Figure may be drawn in any other Proportion.

Let this Plane then repreſent the extreme horizontal Baſis of a Ship a her main Breadth, and alſo ſerve for the Riſing Line, to ſhew the Swin of the Body on a vertical Poſition: And this very Scheme may be mad applicable to for every Part of a Ship's Body.

For let the Semicircle *f*, *c a b*, in the Sheer Plane, be the extreme ha Breadth, the Line *E*, *F*, *G*, in the Floor Plane, the lower Height of the Bread Line, and Narrowing of the Floor Line; and let the Semicircle *I*, *K*, be the Hanging of the Sheering Line; Then *B*, K, *C*, will be the Shee ing Line, which may be made applicable to the Narrowing of the To timber, provided it be properly uſed; for if you deſign a ſquare Stern, and broad Fore Body, then that Diſtance of Breadth the Ship is there, beſid the circular Part, ſhall be ſet off from the middle Line on the Ship's Bod

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Plate VII.

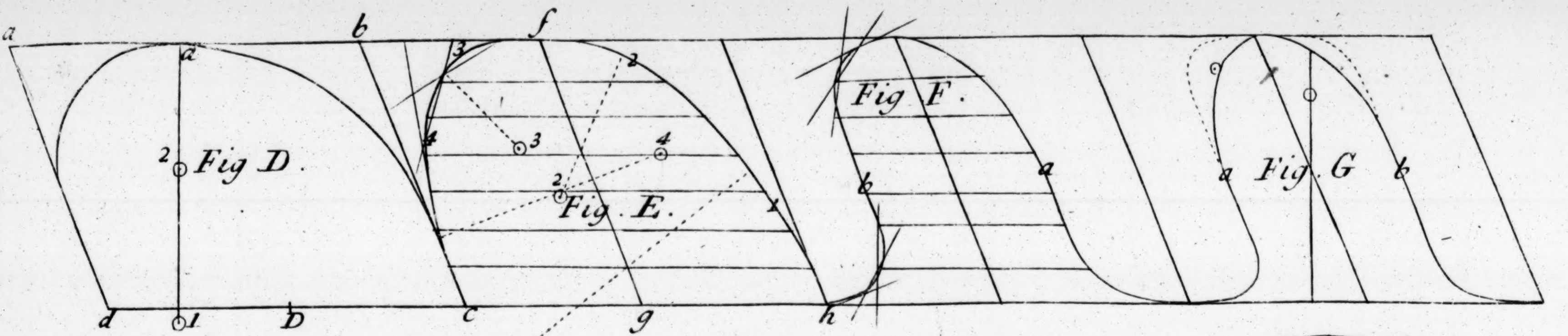
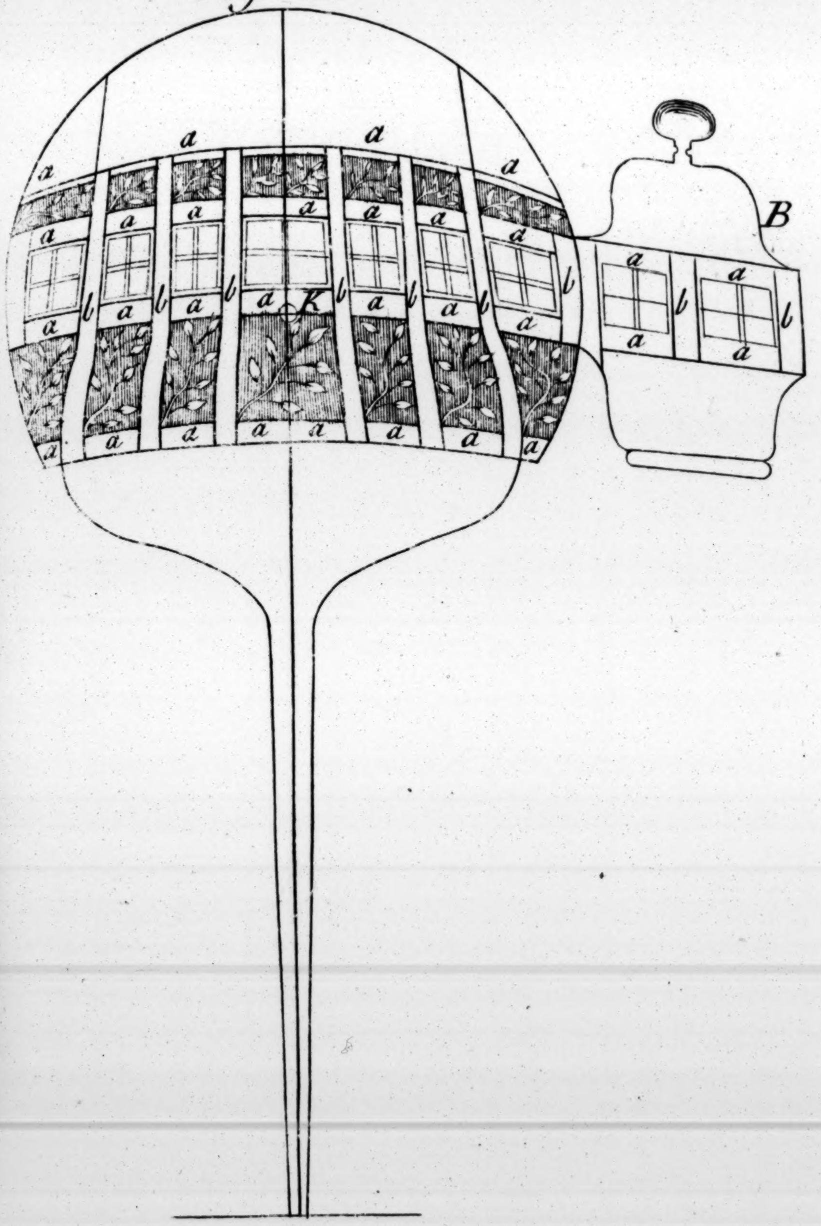


Fig A.



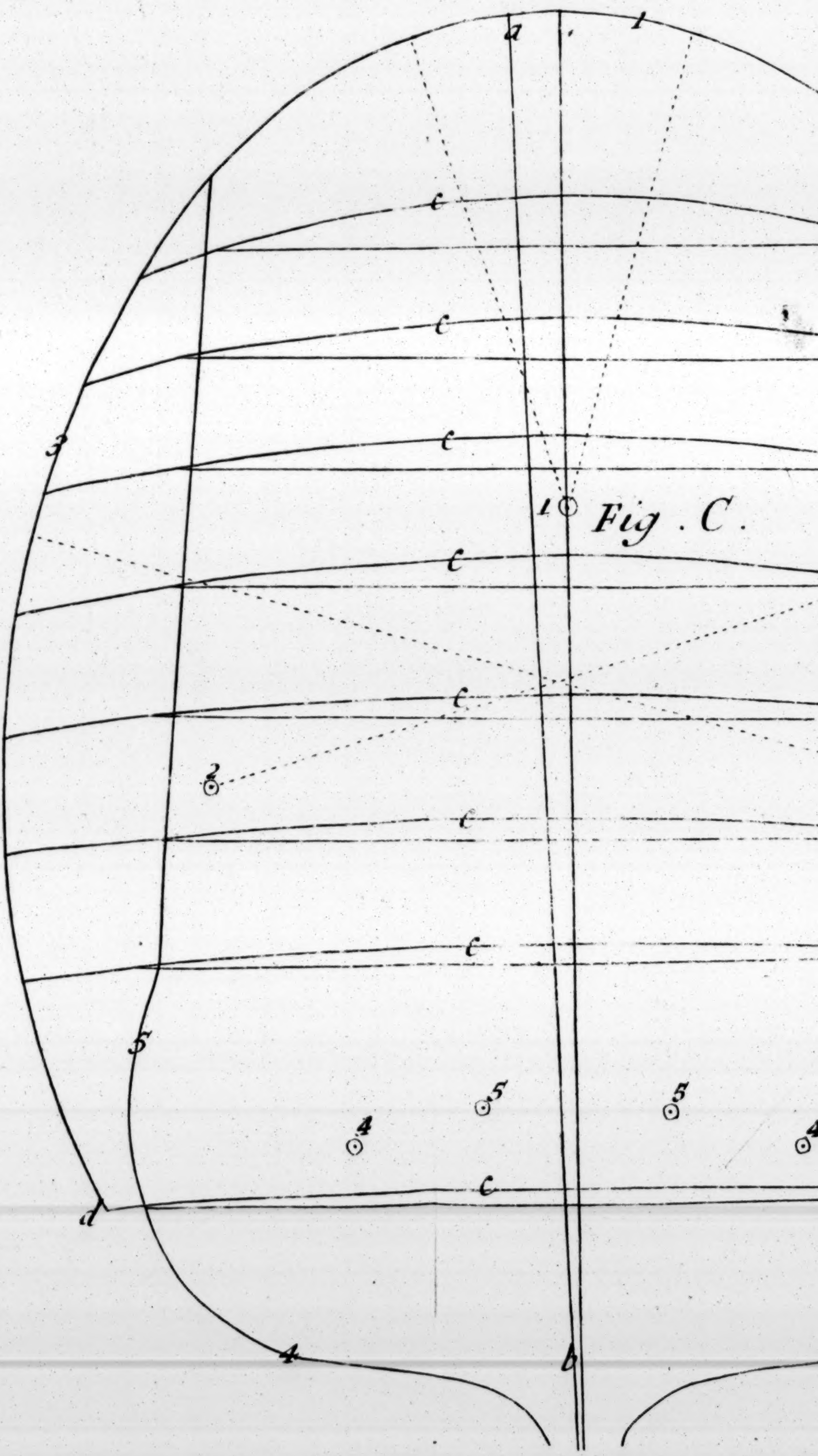
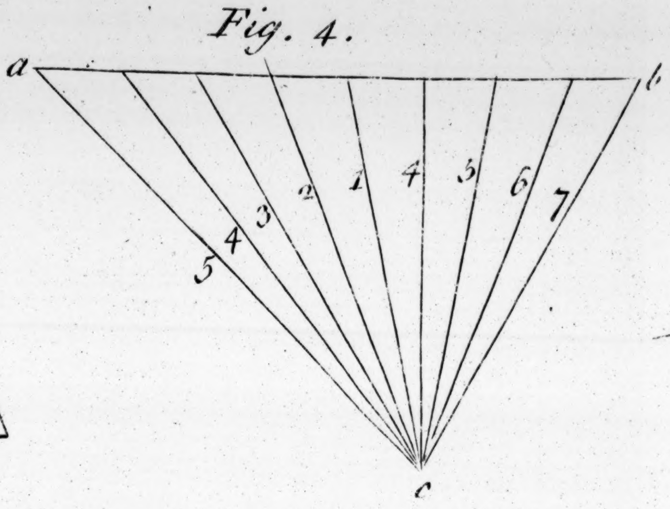
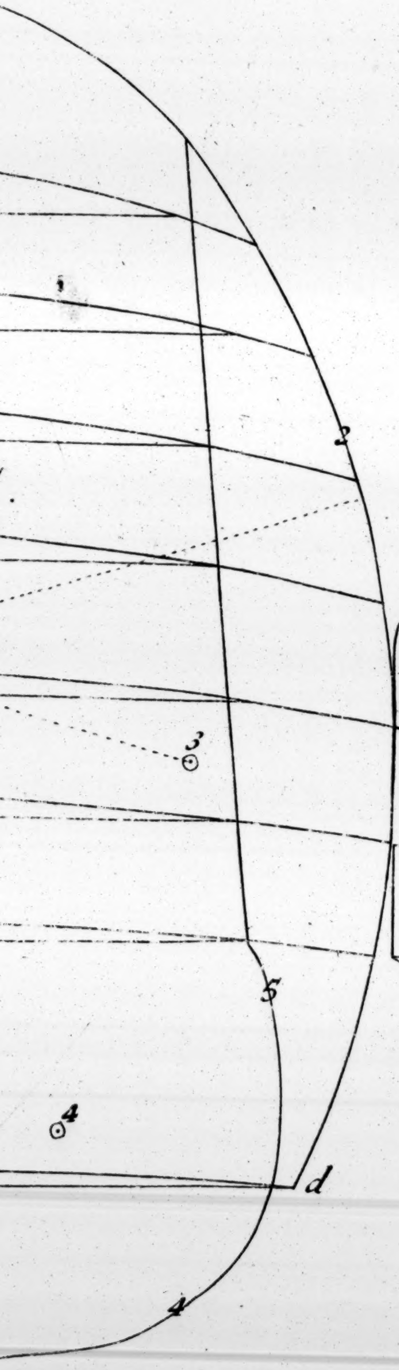


Fig. 4.





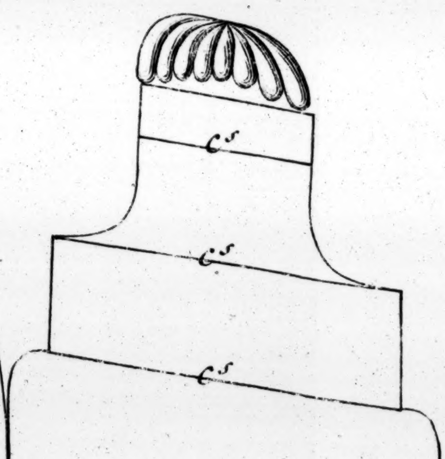


Fig. 5.

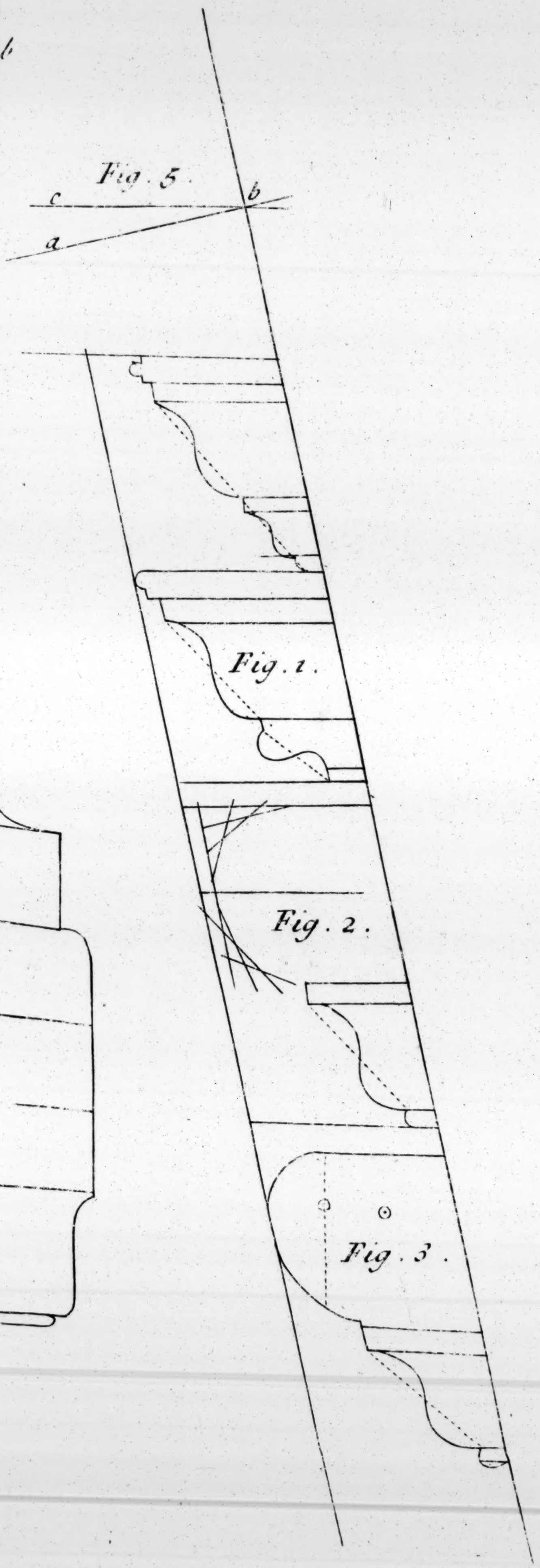


Fig. 1.

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nd d

as a blunt-headed Solid, by whoſe Rotation the Top-timber Line ſhall be formed; and this may ſuffice to ſhew the three tranſverſe Lines, that will ſhape any Ship's Body length-ways.

The Narrowing of the Top-timber Line is *n*, *O*, *P*, being ſimilar to *B*, *K*, *C*, the Riſing Line, which ſhews the Swing of the Body, on a vertical Poſition; *E*, *m*, *b*, the narrowing of the Floor Line being ſimilar to *E*, *F*, *G*. The Knee of the Head is alſo formed by perfect Circles, as the foremoſt round Part 4, 5, ſwept from 6, the cutting down or Sheer of the Knee 1, 3, ſwept from the Center 8; and the Back of the Lion rough 1, 2, is ſwept from 7. And after ſuch a circular Faſhion may every Rail of the Head be formed. But the Gallery is a Rhomboides, ſo that the *Figure* R, in the Sheer Plane being divided into 4 Quarters, and ſubdivided again into equal Parts, draw Diagonals to thoſe Centers, and the oppoſite Quarters are to be ſet off parallel from them.

Fig. B, ſhews the Conjugates or Ribs of a Ship. And theſe Parts may be alſo formed after the ſame Faſhion, as may be ſeen in the Quadrants *e*, *d*, *f*, and *c*, *d*, *e*; *e*, *d*, being the narrowing of the Floor; *g*, the middle Line; the Circle *d*, *f*, ſwept from the Center *e*, and that Quadrant transferr'd to the Quadrant *e*, *c*, *d*, forms the Girt of the Ship's Body below the Breadth. *c*, is the lower Height of Breadth, and the Reaſon of having two Heights is, firſt, to make a Ship carry a greater Burden by continuing the Breadth; ſecondly, to cauſe her to carry Sail, and alſo render the Top-timbers beautiful, in making the Curves both ſhorter and more gibbous.

Fig. C, E and D imitate the Cycloids or Trochoids, laid down by Mathematicians as follows. Let a Wheel or Circle *A* be imagined to make one intire Revolution on a Right-line *a*, *b*, ſo that the Point of the Wheel *a*, when it comes to the Point *b*, will deſcribe a Curve equal to the Periphery of the Wheel that acts upon ſuch a Line.

In *Fig*. C and D, may be ſeen, that by equally deſcribing the Arches , *a*, *a*, extended in as many Parts as you pleaſe, ſo that the Proportion of Length to the Breadth may be according to any Dimenſion; then by dividing the Circles *d*, *B*, into as many Parts as you pleaſe, and by taking he Diſtance of every equal Part on the Circle, from the Line *B*, *B*, and etting it off on the Arch's *a*, *a*, *a*, you will deſcribe the Curve *B*, *d*. And after ſuch a Manner may every circular Part of any Ship be laid down nd demonſtrated.

But ſuch Figures only ſhew the Method for round or pink-ſterned Ships; tho' in deſcribing the Narrowing of the Top-timber Line it may be taken for a ſquare or broad ſterned Ship. But without ſome other Conſiderations, broad ſterned Ships will be found unnatural, and only regarded for Accommodation above Water. And if ſuch Veſſels were conſidered in the Manner as they ought, they would be produced from ſuch a Faſhion; firſt, by drawing the Curve to a Period, and then biſecting it at the aſſigned Length. And the Conveniency in ſuch Sterns is to have Breadth to make Windows, to enlighten the Great Cabin, and other Apartments. But ſuch Sterns ought to be very well ſecured with Timbers, Tranſoms, and Knees. The Beauty conſiſts in the due ranging and exact curving the Rails and Brackets, and making the Galleries ſuitable to the Sterns, as may be ſeen in the *Figures* A, B, and C, D. *Plate* 7.

Fig. A repreſents the Stern and Gallery of a Sixth Rate. The Rails are marked *a*, and Brackets *b*, there being one Tire of Lights to enlighten the Great Cabin. Above and below that Light is ſhadowed Freeze. The Gallery B, ſuits the Stern in Beauty and Uniformity, tho' the Gallery makes almoſt a Right-Angle with the Flat of the Stern, when fixed on the Ship's Side. The Extremes of the Stern are a perfect Circle, and ſwept from the Center *K*, and will appear more beautiful than any other Curve whatſoever. For 'tis not to be imagined that a perfect Circle, ſwept on the Flat, will appear ſo to the Eye, looking on the Rake of the Stern of any Ship.

Fig. C, repreſents the Stern of a three Deck Ship, which is the biggeſt Size, the Extremes of which are very different from a Circle, and therefore cannot be ſo performed: It muſt therefore be ſwept by 3 Sweeps, 1, 2, and 3, the Rails *c* are curved by diminiſhing the Line *a*, *b*, which ſhews that ſhips Decks ſhould increaſe their Heights upwards in the Middle, being the Place of the principal Acting in any Ship, for two Reaſons. For firſt it vents the Water out of the Scuppers, and then it keeps the Deck down at the Ship's Side, cauſing a Ship to be ſnug; but the Beauty of it conſiſts in this, that the Surface of the Water appearing to the Eye perfectly ſtrait, and the Sky circular, by making ſuch Rails round upwards, they the more nearly imitate Nature, and ſeem to join in a due Order and Decorum.

The Gallery Rails *c*, *c*, *c*, are deſcribed by holding a ſtrait Ruler at the Height of your Stern Rail, in the Middle of the Stern, and alſo at the Extremes, and ſo drawing a ſtrait Line for each Rail of the Gallery: But then the Round of the Stern ought to anſwer the Quickening of the

Plate VIII.

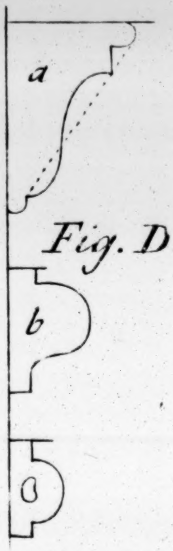

Fig. D.

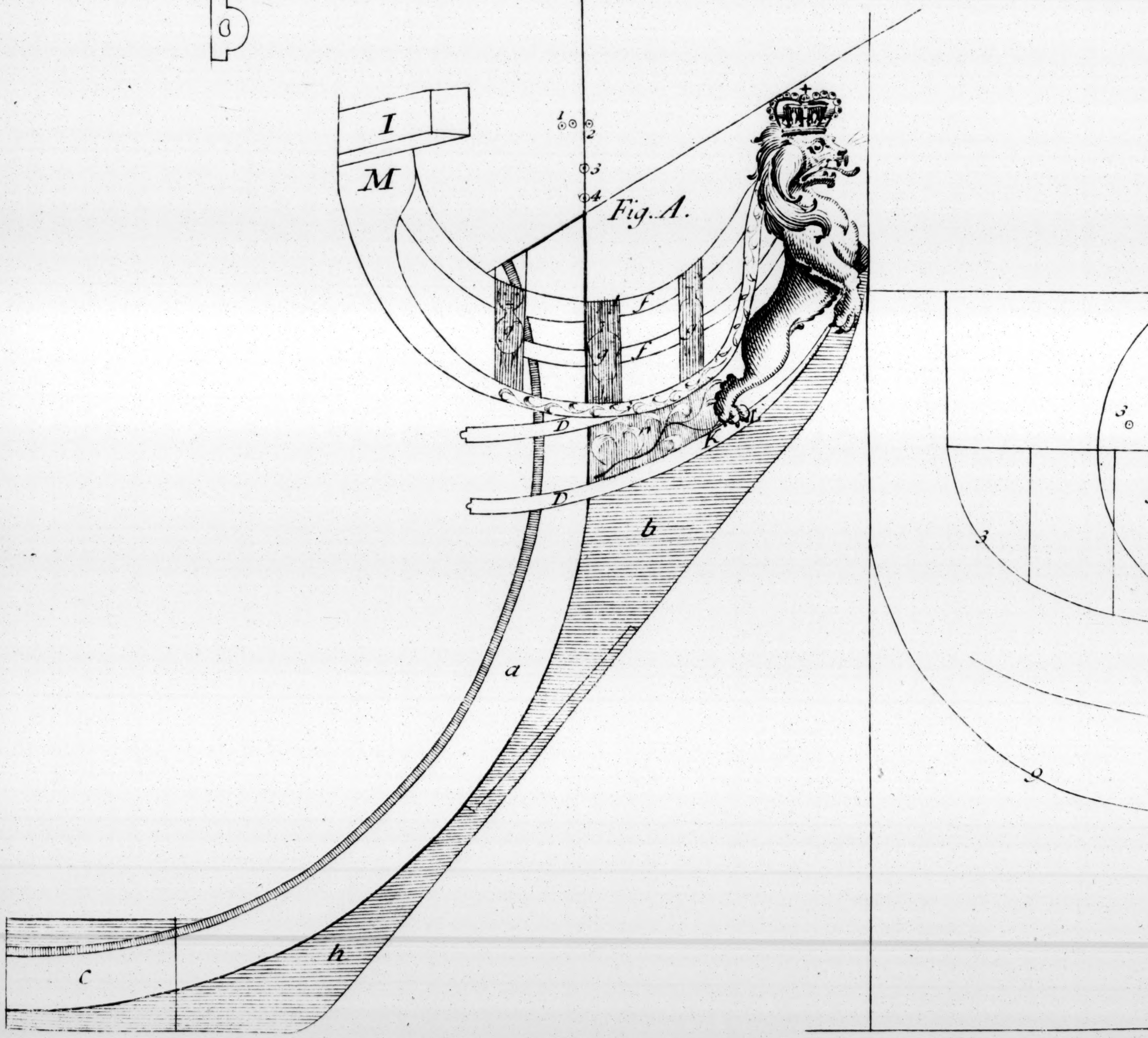

Fig. A.

Facing Page 98.

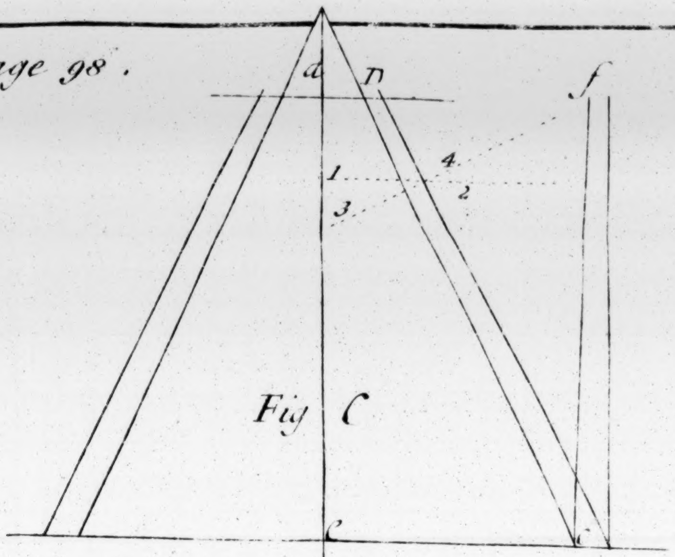

Fig C

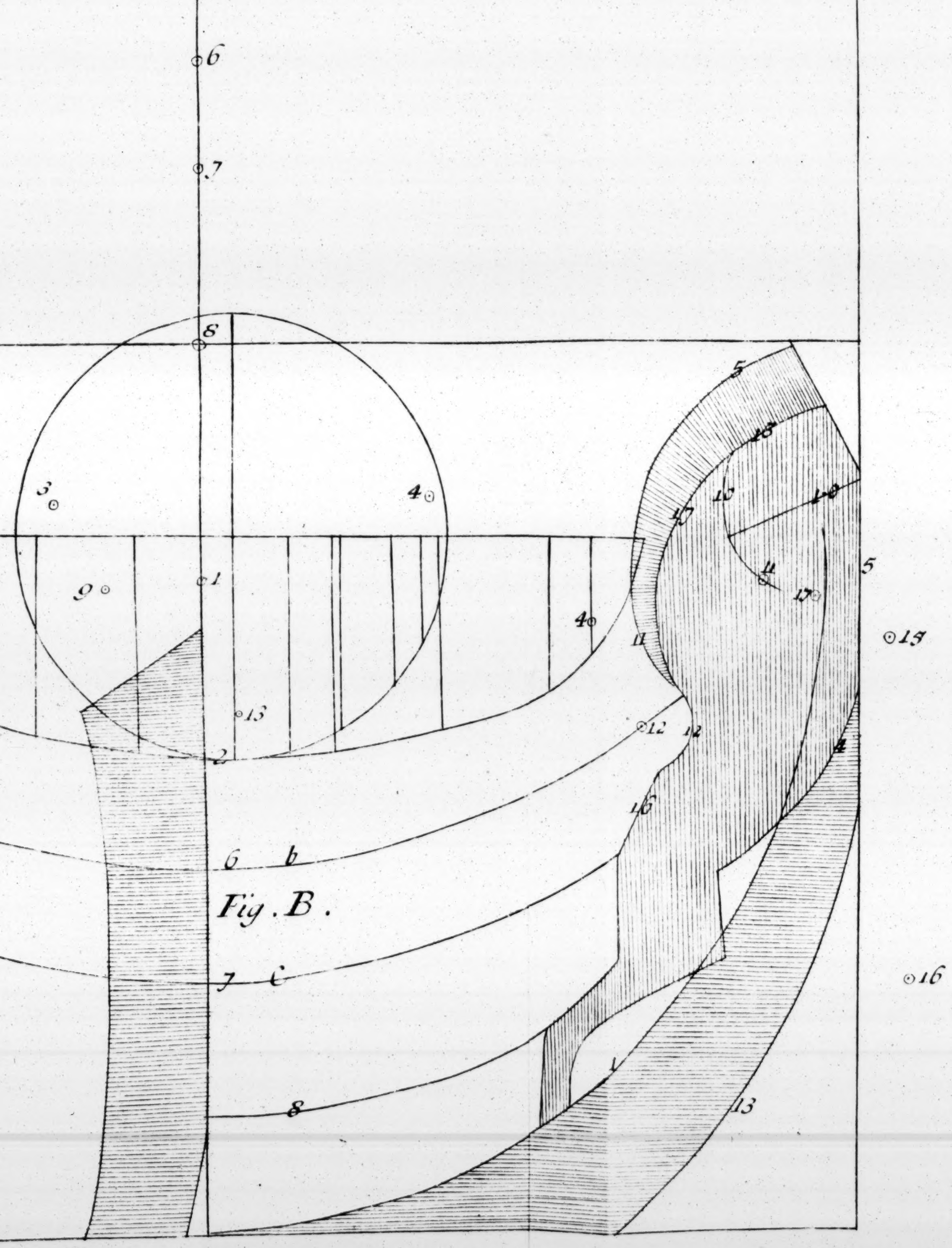

Fig. B.

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r of the Side, which is a Method altogether impracticable, but at
Place, ſince all the Rails of the Gallery ought to lie parallel, and the
n Rails variouſly rounding.

is the upper Edge of the Wing Tranſom, and the Height of the
r Part of the Gun-room Port; as alſo that Place where generally the
me Breadth of the Ship lies abaft. 4, 4, is the Sweep below the
dth, and 5, 5, the Sweep above the Breadth.

he Stern of a Ship is faſhioned like a Rhombus, raking aftward,
ng the Ship commodious and beautiful, as Length is always allowed
o; beſides it anſwers the Rake of the Poſt, which ought to rake for
Conveniency of Planking. *Fig.* D, is a raking Arch, ſwept from two
ers, 1 and 2, bounded by a Rhombus *a*, *b*, *d*, *c*, which may be called
Top of a Gallery, and ſuiting the Rake of the Stern; and by letting
he Perpendicular *a*, 1, from the Middle of the Line *a*, *b*, it deſcribes
ne wherein the Centers are found, 1 and 2.

g. E, is of the ſame Nature, only deſcribed after another Manner,
h is to divide the Limbs *b*, *f*, and *b*, *c*, into equal Parts, and by
ing interſecting Lines, the Arch *f*, *c*, paſſes through their Interſections;
ſetting off equal and parallel Diſtances of that Arch from the middle
g, *f*, the other way it deſcribes the Arch *f*, *b*; it may alſo be ſwept
the Centers 1, 2, 3, 4.

g. F and G, are Raking Bells, repreſenting the Top of a Gallery,
may be deſcribed as the other Arches are, only obſerving the Points
nflection *a* and *b*. From ſuch Methods may any faſhioned Gallery
ormed.

g. 1, 2, 3, are the Rails of the Stern diminiſhing upwards. It ought
to be obſerved, that all Rails which are placed on the Stern of a Ship,
ld round more than what is allowed to appear in Sight, as much as
Difference is between the Rake of the Stern and a perpendicular
, conſidered according to the Round of the Rail that you allow aft-
. As in *Fig.* 5, you may obſerve, that the Line *e*, *b*, is a Parallel
n from the Stern Side-timber, and the Line *a*, *b*, perpendicular to it:
refore ſince all Stern Rails project perpendicular from the Stern, the
rence of the Rounding ſhould be according to the Difference between
parallel and perpendicular Lines in the rounding of every Rail.

he Head of the Ship ſerves for little elſe than Ornament (for ſeveral
s have no Heads) ſince its chiefeſt Conveniency is to tack the Weather
of the Fore-ſail forward, to gammon the Bowſprit, to water the
iſion, and for Houſes of Eaſe. As to the tacking the Fore ſail for-
, it has a principal Uſe to trim the Sail to the Wind, that the Lee

Leetch may not bag, and oppoſe the Motion of the Ship: And then it may be conſidered, whether ſuch over ſhort Heads are proper, from the Diſtance there is between the Main-maſt and the Cheſſe-tree, that tacks the Main-ſail forward.

The Beauty of this Part is more admired, and its Deformities ſooner diſcovered than any other Part; for the Heads of all Creatures are moſt obſerved by all competent Judges, and the Symmetry of the whole depends much on the Proportion or Diſproportion it bears to the Head: For to ſee a Head with all its Parts well and neatly formed, and a due Proportion and Harmony between them, ſtrikes with Admiration the Eye of the Beholder. From ſuch Obſervations the Head of any Ship may be faſhioned, ſo as to make it beautiful, that is, to form it perfectly circular, if the Dimenſions will bear it; but if not, by Ellipſis's, or ſpiral Spaces.

Plate 8, *Fig*. A, repreſents the Head of a Ship of 250 Tons. *a*, is the Stem; *c*, the fore Foot, or where the Stem and Keel are ſcarfed; the Keel at the foremoſt End is left big enough to bear the Stem's being let into it, beſides a Butt left for the Gripe to join to; *b*, is the Gripe; *b*, the Knee of the Head, or principal Piece, faſtened to the Stem, with Bolts ſuitable for that Purpoſe, the Knee being ſcantled to ſuit the Stem as it is joined to it: But the foremoſt Part of the Knee is barded away as ſharp as it can conveniently be, termed a Cut-water. The upper Part of the Knee is generally two-thirds at the Lion's Breaſt, and wrought taper. *D*, are the Cheeks, being Knees bolted through the Knee of the Head, and to the Ship to ſteady the Knee.

In hewing of Cheeks this Method ought to be obſerved, to make a Mould to the cutting down of the Knee of the Head *D*, *K*, *L*, and prolong that Mould parallel with the Rounding or Sheer of the Harping, as far as the Cheeks are to be placed; then inſtead of hewing the Cheeks as cuſtomary, by putting them on their Ends, and hewing them perpendicular from the Breech, hew them by the hanging of ſuch a Mould, which will give the true hanging of the Cheek at the Stem or Middle of the Cheek; *f*, *f*, are the Rails of the Head, the uppermoſt being truly circular, as are likewiſe all the other. Although the Notion among Shipwrights is, that ſuch Rails cannot, nor ought to be truly circular, which I only take to be an Amuſement to the young Practitioner, as in many other Caſes, it being the Buſineſs of moſt Shipwrights to ſuppreſs and keep back the grand Principles of the Art from young Beginners. Such Rails ought alſo to diminiſh forward. An Inch in twelve Feet will be ſufficient, meaſured on the Circle of each reſpective Rail.

The upper Side of the upper Rail in the Middle ought to be level, for e Conveniency of Mens ſtanding on them, and that the Gratings may o lie level, and out of winding with the Rails. The after Part of the il ought to bevel to the Cat-head, and bolted to the ſame, which is rked *I* in the Figure. The foremoſt Part of the Rail, if you ſquare it, cuſtomary, will want Wood on the out-ſide, when in its Place; and e Reaſon is from its ſpreading a great deal more Abaft than Afore, as ay be ſeen in Figure C. Let *a*, *e*, repreſent the middle Line; *e*, *c*, the eading of the Rails at the after End, and *a*, *D*, the ſpreading at the emoſt End; *c*, *f*, being parallel to the middle Line; ſo that the Want the beveling of the Rail at the foremoſt End is, as the Line 3, 4, to the ne 1, 2, which is chiefly cauſed by the Circle of the Rail; for that Part the Rail, which lies level and perpendicular to the Horizon, will always ſo, let the ſpreading of the Rail be what it will; I mean the middle rt of the Rail. *g*, *Fig.* A, are Brackets, and Timbers on the inſide of e Brackets, the Timbers being the principal Security to all the Uſes of e Head, as the Jack-piece in particular; *e*, is the Lyon (ſome Ships ve the Figure of a Horſe, &c.) *n*, the Trail which is curved, though would be better if otherwiſe, ſince the Bolts that faſten the Timbers, elſons, and Standers, go through the Trail; and ſometimes for want of oper Care, ſuch Bolts lie bare, which conſequently muſt be very pre-dicial.

l, is the Cat-head, where two or three Shivers are put, to make a Pur-aſe to hoiſt the Anchor out of the Water, after the Cable has brought to the Hawſe-hole. *M*, is a Supporter to the Cat-head.

Fig. B, repreſents the Head of a Ship of 1000 Tons, the upper Rail *a*, eing curved by the Method of a Wheel or Circle. However, the Center ſweeps the middle Part, and 3, 4, the other two Parts, only forward e Curve is reverſed; 5, ſweeps that which makes the Top of the Crown, ough ſometimes the upper Rail terminates, as the Arch 15; 10, ſweeps e Poll of the Lion; 10,& 11, the aft Part of the Locks; 4, the Breaſt, 12, e Back. The other Parts of the Lion are formed ſtrait before it is carved; d after the ſame Manner may every Part of a Lion be rough ſhaped. , ſweeps the middle Rail *b*; 7, the lower Rail *c*; and 9, the Raking, or wer Part of the Supporter, anſwering the lower Rail. 8, ſweeps the pper Part of the Lace, to which the upper Cheek is faſtened. 1, ſweeps e cutting down of the Knee, and 13, the foremoſt Part of the Knee. fter ſuch an intelligible Manner may every Part of any Head be de-onſtrated, without ſo many confuſed and perplexed Methods as are ſtomary. *a*, *b*, *c*, *Fig.* D, is the Shape of imboſſing the Rails; *a*, the permoſt; *b*, the middle, and *c*, the loweſt Rail.

A TABLE

A TABLE
OF THE
SCANTLING or MEASURING
OF THE
TIMBERS in a SHIP of near 500 Tons.

Keel of Elm in 4 Pieces, if poſſible.	Feet	Inch.
Squar'd in the Midſhips	1	2
Length of the Scarph	4	1
Bolts, 8 in Number, of the Bigneſs	0	0,95
Falſe Keel, Elm	0	3,3
Taper'd at the After-end thwart-ſhips	0	9,2
Stem of Oak in two Pieces, as aforeſaid		
Breadth Fore and Aft	1	2,8
Thwart-ſhips	1	0,98
But as big as the Bowſprit upwards.		
Length	32	—
Falſe Stem's Breadth	1	10,9
Thickneſs	0	8,1
Stern-poſt, Oak, in Length	32	—
Fore and Aft at the Head	1	5,2
Thwart-ſhips at the Head	1	5,3
Fore and Aft upon the Keel	2	1,8
Falſe Poſt Fore and Aft allow that within-ſide	1	2
Falſe Poſt Fore and Aft allow that without-ſide	0	9
Faſhion Pieces ſided	0	10

Tran-

	Feet	Inch.
Tranſoms { Wing and Deck-ſided	0	11,4
Tranſoms { Thoſe below the Deck	0	10
Common Space between	1	1
Knees of every whole Tranſom ſided	0	10,7
The Wing Tranſom to have a long arm'd Knee	12	6
Space of Timber and Room	1	$9\frac{1}{2}$
Floor Timber ſided	0	$9\frac{4}{10}$
Up and down on the Keel	1	2
In and out at the Floor-head	0	10
Length	17	2
Top-timber Length	12	8
Fore and aft } at the Head	0	8,6
In and out } at the Head	0	2,4
And all other Timbers (as Foothooks) between the Floor and Top-timber Head, to be ſcantled by a diminiſhing Line ſtruck from the Length of the Body, on the Girt ſet off from the Keel to the Top-timber Head.		
Foot-hooks, Number of Tires, N° 3.		
Length	13	3
Scarph, at leaſt	5	6
Thickneſs in and out at the Breadth	0	7,5
Lower Foot-hook ſhort of the Keel	0	11,4
Every other Floor-timber to be bolted through the Keel with a Bolt in Diameter	0	1,2
Hawſe Pieces in N° 4, Breadth	1	10
Keelſon ſcor'd into the Floor-timbers	0	1
Thwart ſhips	1	3
Up and down	1	2
Thick Strakes on each Side the wrung Heads, N° 6.		
The middle one in Thickneſs	0	6,6
The Extremes in Thickneſs	0	5
Each in Breadth	1	1,6
Two Strakes of middle Bands in Thickneſs	0	5,7
One Strake next the Timber Boards	0	5,7
Two Strakes of Gun-deck Clamps { Upper thick	0	6
Two Strakes of Gun-deck Clamps { Breadth	1	3,5
All the reſt of the Foot-waling in { Thickneſs	0	4,3
All the reſt of the Foot-waling in { Breadth	1	1

Orlop

	Feet	Inch.
Orlop Beams, N° 8.		
Fore and aft	0	11
Up and down	0	9,7
Thoſe under the Store-rooms ſided	0	8,5
Up and down	0	7,9
Bends of Riders N° 4.		
Floor Riders fore and aft	1	1,4
Up and down on the Keelſon	0	9,9
In and out at the Extremes	0	10,9
Length	16	11
To be bolted in every 20 Inches Space, with Bolts in Diameter	0	1,2
Foot-hook Riders Length of Scarph	6	6,6
Fore and aft	1	1
Up and down	0	9,9
Top Riders (if any) fore and aft	0	9,1
In and out	0	8,9
Crutches aft, N° 2.		
Sided	0	9,5
Each Arm to be in Length	4	10,5
Step of the Main-maſt fore and aft	1	11
D° Fore-maſt	1	10,5
D° Mizon-maſt	1	2,2
Breaſt-hooks, to place one under each Deck, one under the Hawſe-holes, and in hold before the Step of the Fore-maſt N° 4.		
To be in Length	10	9
Depth up and down	0	10,9
To be bolted in every 20 Inches		
The Well to be built with Oak Plank.		
Thickneſs	0	2,9
Pillars to each Beam of the Gun-deck.		
Square	0	5,9
Croſs Pillar ſquar'd	0	7,9
Gun-deck Beams to round	0	4,8
To be fore and aft	1	1
Up and down	0	11,7
To be Dove-tail'd into the Clamps	0	2
And doubled Knee'd	—	—

Each

	Feet	Inch
Each Knee ſided	0	8,5
The up and down Arm of the hanging Knee Length	3	11
The other no leſs than	3	4,5
To be bolted in every 16 or 18 Inches, with Bolts Diameter	0	1,1
The Beams to lie one under, and one between each Port, except in the Main-hatch-way, and in the Wake of the Main-maſt.		
Clear of the Main-hatch-way fore and aft	6	8
Thwart-ſhips	5	8
Carlings, Tires of each Side 2, and in ſome Places leſs, according to the Tapering of the Ship.		
Carlings Depth up and down	0	7,1
Thwart-ſhips	0	10,6
Ledges to lie aſunder	0	8
Depth	0	3,8
Breadth	0	4,5
The Flat of the Deck Oak Plank, of	0	2,9
Port of each Side N° 11, fore and aft	2	8
Up and down	2	3
From the Deck Plank to the upper Part of the lower Cell	2	1
Cable Bit-pins, and the aftermoſt ſquare at Head	1	3,5
Fore-maſt ditto	1	1
To continue the Subſtance below the Beam, and then to Taper half at the Heel.		
Croſs-pieces one Inch deeper than the Square of the Pins, and to be fore and aft	1	5,4
Partners of the Main-maſt	0	7,9
Fore-maſt	0	7,3
Capſtand and Mizon-maſt	0	5,5
Lead Scuppers various in Number and Diameter, but of Lead that 10 Pound weight be a Foot in Meaſure.		
Standers, Number on each Side 4.		
Sided	0	11,6
Spirkit-riſing, Thickneſs	0	4
Lining between the Ports	0	3
Partners or Step for the Bowſprit	0	6,2

	Feet	Inch
Main Capſtan, Diameter at the Barrel	2	1
Upper Deck Clamps thick	0	4,2
Beams the longeſt to round	0	7
Fore and aft	0	9,4
Up and down	0	8,3
Carlings, Depth	0	5,1
Breadth	0	6,2
Ledges, Depths	0	3
Breadth	0	3,7
Knees ſided	0	5,9
To be bolted in 18 Inches Square with Bolts of Diameter	0	0,8
Standards on each Side, Nº 3.		
Sided	0	7,7
Plank or Deal, in Thickneſs	0	2,3
Ports fore and aft	2	4
Up and down	1	11,5
Height from the Deck Plank to the Cell	1	6,8
Spirkit-riſing, in Thickneſs	0	3
String under the Ports pricked home to the out-board Plank, String's Thickneſs	0	4,5
And to be left without the Spirking-riſing	0	1,2
String above the Ports to be ſcored ¾ of an Inch about the Timbers. Thickneſs	0	2,9
Topſail Sheet and Jeer-bits Main, Square at the Head	0	9,5
Long coming Carlings for the Gratings. Depth	0	10,1
Breadth	0	8,7
Bulk-head Brackets of the Steerage and Forecaſtle ſided	0	7,5
Forecaſtle Clamp of Oak, in Thickneſs	0	3,1
Breadth various, according to the Height from the Forecaſtle Deck to the Ports		
String in the great Cabin of Elm, into which the Beams ſhall be dove-tailed, and bolted in every 16 Inches.		
Bolts Diameter	0	0,8
String cut on the Beveling of the Side	0	10,1
Depth	0	8,7
Thickneſs	0	6,2
Beams the longeſt to round	0	9,9
Fore and aft	0	7,3
Up and down	0	4,8

	Feet	Inch.
To lie 2 Feet, or 2 Feet 4 Inches aſunder.		
Knees ſided	0	4,3
Bolts Diameter	0	0,6
Plank of the Deck in Thickneſs	0	2
Quarter-deck Ports Fore and aft	1	7,5
Up and down	1	6,8
Height from the Deck	0	11,4
Spirkit-riſing in Thickneſs	0	2,9
Bits about the Fore-Maſt ſpare	0	8
Cat-heads ſquare, or to be 2 Inches. Bigger fore and aft than up and down.		
Square	0	11,9
To ſtave in every Foot	0	2
Length without the Side, according to the various Bluffneſs or Flaring of the Bow.		
But, as cuſtomary	4	3,3
Poop Beams to lie aſunder	1	5,4
The longeſt to round	0	9,9
Fore and aft	0	5,1
Up and down	0	3,4
Ports fore and aft	1	3
Up and down	1	3
Height from the Cell	0	10,1
Without Board	—	—
Plank wrought at the Bottom	0	3,5
To faſten well with Trenels in Diameter	0	1,8
Plank wrought at the Breadth, thick	0	5
At the Top-timber Head	0	2
Lower Wale, Up and down	1	2
In and out	0	8,5
Upper Wale, Up and down	0	11,5
In and out	0	8
Lower Chain Wale, Deep	0	8,7
Thick	0	4,7
Upper Chain Wale, Deep	0	8,4
Thick	0	4,2

	Feet	Inch.
Main Channels, Length	24	6
Breadth At the After-end	2	—
At the Fore-end	1	11
Thickneſs	0	5,1
Number of Shrouds 6	—	—
Fore Channels, Length	18	10
At Breadth the After-end	1	8,4
At the Fore-end	2	2
Thickneſs	0	4,3
Number of Shrouds 6	—	—
Mizon Channel, Length	11	0
Breadth at the After-end	1	2
Fore-maſt End ditto	1	1
Thickneſs	0	3
Number of Shrouds 4	—	—
Sheering Rail Depth at the Gunnel	0	5
Stern Tire of Brackets next above the Counter	1	0,4
Quarter-pieces ſided	1	6
Gallery Brackets ſided at the lower Lights	0	8,7
Rudder at the Head Fore and Aft	1	7,5
Thwart Ships	1	5
Fore and Aft allow	4	2
Rudder Irons, 6 Pair		
Term Pieces, or Drift Pieces ſided	0	9,8
Counter Rail to round upon the Flat of the Stern upwards	0	9
Outwards	0	7,5
Depth	0	10
Length of the Head afore the Stem	10	5
Lower Check ſided	0	9
Great Rail at the After-end, beſides the Planſhire Fore and Aft	0	10,5
Bracket againſt the Stem ſided	0	11,6

A TABLE of the Number of Ports and Weight of Guns to Ships of different Rates.

A Ship of 100 Guns			of 90 Guns		of 80 Guns		of 74 Guns	
Decks	Ports		Decks	Ports	Decks	Ports	Decks	Ports
1	14	On each Side	1	13	Lower	13	Lower	14
2	15		2	13	Middle	13	Upper	14
3	14		3	13	Upper	12	Quarter	8
Quarter	4		Quarter	5	Quarter	2	Fore-caſtle	1
Fore-caſtle	2		Fore-caſtle	1	On a Side	40	On a Side	37
Poop	1		On a Side	45			i.e. on each Side	

Of 64 Guns		60 Guns	50 Guns	44 Guns	24 Guns
Lower-deck	13	12	11	10	1
Upper	13	12	11	10	10
Quarter	5	4	2	2	1
Fore-caſtle	1	1	1	—	—

Note, That a 100 Gun Ship has Guns upon the	90 Gun Ship	80 74 Gun Ship
Lower-deck, that carries——42 Pounders	32 Pound	32 Pound
Middle-deck —24	18	18
Upper-deck —24	12	9
Quarter & Forecaſtle 6	6	6

A 74 and 64 Gun Ship carries on the		60 and 50 Gun Ships	44 and 40 Gun Ships	24 and 20 Gun Ships
Lower-deck	32 Pound	24 Pound	18 Pound	9 Pound
Upper-deck	18	12	9	9
Quarter	9	6	6	3
Fore-caſtle	9	6	—	—

A TABLE *of the Dimenſions of the Ports, according to the Weight of of the Shot.*

Shot	Height of Port		Breadth of Port		Height of the Port ab. Deck.		A TABLE of the Length, Breadth and Depth in the Hold of Ships.			
Pou.	Ft.	In.	Ft.	In.	Ft.	In.	Guns	Length	Breadth	Depth
42	2	10	3	2	2	4	100	224	54	24ft.
32	2	8	3	0	2	3	90	200	50	23
24	2	6	2	10	2	1	80	180	46	22
18	2	5	2	8	2	0	74	166	43	21
12	2	3	2	5	1	11	64	150	41	19½
9	1	10	2	0	1	9	50	140	40	18
6	1	4	1	6	1	6				

Note, That theſe Lengths, Breadths and Depths, are taken for a Mean of their general Dimenſions.

Of MASTS and YARDS.

The Main-maſt two five-eights, or two and a half the Breadth of the Ship.

The Head of the Maſts one-tenth of the Length.

The Diameter of the Main-maſt three-fourths of the Inches, the extreme Breadth is in Feet; and the Diameter of its Top two-thirds of that at the Partners.

The Fore-maſt two and a quarter the Breadth of the Ship, and its Diameter one-fortieth of the Length, or one-tenth, one-eleventh, or one-twelfth of the Breadth.

The Bow-ſprit one and a half the Breadth of the Ship, and its Diameter at the Bed the 27th or 28th Part of this Length, and at the Cap of half that Diameter.

The Mizon-maſt one and three-quarters the Breadth of the Ship, and its Diameter at the Partners in Inches the 48th Part of its Length in Feet.

Proportions for TOP-MASTS.

The Main-top-maſt the ſame Length as the Bowſprit; and the Diameter at the Cape, about the forty-fourth Part of its Length.

The Fore-top maſt one three-eights the Breadth of the Ship; and the Diameter at the Cape the 43d or 44th Part of the Length.

The Mizon-top-maſt half the Length of the Main-top-maſt, and its Diameter at the Cape, half the Diameter of the Main-top-maſt.

The Main-top-gallant-maſt five-twelfths of the Length of the Main-top-maſt, and half its Diameter.

The Fore-top-gallant-maſt four-ſevenths of the Length of the Fore-top-maſt.

The Sprit-ſail Top-maſt two-fifths of the Main-breadth, and its Diameter the 24th or 25th of the whole Length.

Proportions for YARDS.

The Main-yard two one-eighth of the Main-breadth; Diameter at the Slings two-thirds of the Main-breadth, Inches for Feet; they taper towards the Yard-arms, where the Diameter muſt be one-third of that at the Slings.

The Main-top ſail-yard in Length one and a quarter of the main Breadth, and the Diameter at the Slings half that of the Main-yard.

The Main top-gallant yard in Length three-quarters of the Main-breadth, and the Diameter at the Slings half of that of the Main-top-ſail-yard.

The Fore-yard twice the Main-breadth; Diameter at the Slings five-eights of the Breadth, Inches for Feet.

The Fore-top-ſail-yard one one-ſixth the Main-breadth; and its Diameter ſeven-fifteenths of that of the Fore-yard.

The Fore-top-gallant-yard two-thirds of the Breadth; and its Diameter half that of the Fore top ſail-yard.

The Sprit-ſail-yard one and a quarter the Main-breadth; and its Diameter at the Slings half that of the Main-yard.

The Spritſail-topſail-yard three-quarters of the Main-breadth, and its Diameter ſeven-ſixteenths of that of the Spritſail yard.

The Mizon-yard twice the Breadth of the Ship; and its Diameter one-third of the Breadth, Inches for Feet.

Croſs-jack and Sprit-ſail-yard, the Length of the Fore-top-ſail-yard; and Sprit-top-ſail-yard, that of the Fore-top-gallant-yard, Some Maſt-makers proportion the Diameters of Maſts and Yards in the following Manner.

The Main and Fore-maſt one Inch to each Yard in Length.

Top-Maſts 9-10ths of an Inch for each Yard in Length.

Fore Top-Maſts the ſame as the Main-top-maſt.

Top-gallant-maſt, for each Yard in Length, one Inch.

The Main and Fore-Maſt one Inch to each Yard in Length.

Mizon-maſt, for each Yard in Length, 7-10ths, or 15-22 of an Inch.

Mizon-top-maſt for each Yard 5-6ths of an Inch.

Bowſprit for each Yard one Inch and a half.

Flying-jib-boom, for each Yard 7-8ths of an Inch.

Main and Fore-yard, for each Yard 5-7ths of an Inch.

Top-ſail, Croſs-jack-yard, and Spritſail-yard 9-14ths of an Inch per Yard.

Top-gallant, Mizon-top-ſail, and Sprit-ſail Top-ſail-yards, 8-13ths of an Inch for each Yard of Length.

Mizon-yard 5-9ths of an Inch per Yard.

Steering-ſail Booms and Yards, for each Yard half an Inch.

Proportions for the Diameters of Yards, according to their Diameters at the Partners, or Slings.

1ſt. Quarter 27-28ths. 2d. Quarter 9-10ths. 3d. Quarter 7-10ths. Yard-arm 4-10ths.

The lower Arm of the Mizen-yard: 1ſt. Quarter 19-20ths.—2d. 11-12ths. 3d. 10-11ths.—Yard-arm 8-12ths.

Of Heads and Hounds of Maſts.

The Head of the Main and Fore-maſts to be five Inches for each Yard of the Length of the Maſt.

The Mizon-maſt Head four, or four one Sixth for each Yard.

The Top and Top-gallant Maſt-heads, four Inches for each Yard.

The Length of the Hounds four Tenths of their Heads reſpectively.

Of Caps.

The Breadth to be twice the Diameter of their Top-maſts, and their Lengths twice their Breadths.

The Thickneſs of the Main and Fore-caps one Half the Diameter of their Breadths; the Mizen-cap three Sevenths, and the Top-maſts four Tenths of their Breadths reſpectively.

The Flying Gib-boom-cap, in Length five Times the Diameter of the Boom, and in Breadth twice its Diameter, and in Depth nine Tenths the Breadth.

For Truſſel-trees.

Their Length to be three Inches within the outer Edge of the Top.

The Depth of the Main and Fore-truſſel-trees twenty-three twenty-fourths of an Inch for each Foot in Length; and their Breadths five-ſevenths of their Depths.

The Depth of the Mizen Truſſel-trees ſix-ſevenths of an Inch, and their Breadths eleven Sixteenths of their Depths.

The Main and Fore Top-maſt Truſſel-trees in Length one Fifth of the Top-gallant-maſts Length, and Depth twenty-three Twenty-fourths of an Inch for each Foot of Length; and their Breadth three-quarters of their Depth.

The Mizen Top-maſt Truſſel-tree Half the Length of the Main Top-maſt Truſſel-tree; the Depth one Inch for a Foot in Length, and their Breadth five Sixths of their Depth.

For Croſs trees.

The Length of the Main and Fore Croſs-trees to be three Inches within the outer Edge of the Top. The Mizen Croſs-tree the ſame Length as the Truſſel-trees. The Croſs-trees the Breadth of the Truſſel trees, and Half their Depth.

CHAP. X.

Of Proportioning the RIGGING.

THE Center of the Maſts Places is general in all three Maſt Ships. Wherefore having laid down two Figures of Ships by direct Dimenſions, and fitted a Scale for them, the Centers of the Maſts for all other Ships may from thence be found. For as the Proportion any Ships Length is to theſe, ſo are the Centers of the Maſts Place one to another, and may be ſet off from the Stem or Stern-poſt upon either the Gun-deck, or deep Load Markline.

Having deſcribed the Place of each Maſt's ſtanding, I ſhall in the next Place ſhew how the Length and Bigneſs of every Maſt is found, tho' from a Cuſtom ſo very different, that 'tis almoſt impoſſible to make it general.

MAIN-MAST.

The Main-Maſt is the firſt, whoſe Proportion is always found from ſome Part of the Ship, either Length, Breadth, Depth, or Bulk of the Body, and from thence the Dimenſions of all the other Maſts and Yards are taken.

But to ſhew a little the different Methods made uſe of in this Matter; ſome will have it, that the Breadth and Depth of the Ship being added together, and multiplied by 3, and divided by 5, will give the Length of the Main-Maſt in Yards. Others again will take in the Length of the Keel to find the Proportion of this Maſt; which cannot be methodical, ſince two Ships may be of equal Length upwards, or equal in Bulk, and their Keels differ 10 Feet.

Now 'tis my Opinion, that the Length at the Lower Gun-deck ought to be one principal Part in this Caſe, becauſe it is to be very near the Place of Bearing, and where the Body is divided between two Elements. 'Tis alſo near the Place where the Sails are managed; for the Yards, if not the Maſt, ought to be longer or ſhorter, according to the Ship's Length at that Seat. The extreme Breadth of the Ship ought to be another part, ſince the broader any Ship is, the more ſhe will reſiſt the Medium, and the more Sail will be requiſite for her. The Depth ſhould alſo be taken in, being almoſt of the ſame Nature as the Breadth.

To apply this therefore, I take the Length of the Gun-deck, the Main Breadth, and Depth in Hold, and add them together, and take the Half for the Length of the Main-Maſt in Feet, only ſubtracting the Depth of the Main-ſtep out of the Depth in Hold, which Depth of the Main-ſtep I allow to be one-ſixth of the Depth in Mold, *viz.* Feet In.

Length on the Lower Gun-deck from the Inſide of the Rabbets—150 : 0
Breadth from the outſide of the Plank—— —————————— 40 : 0
Depth in Hold 16 : 0 ————————————Leſs by one-ſixth is 13 : 4

Sum 203 : 4
Half Sum 101 : 8

Which half Sum, divided by 3 gives 33 Feet 10 Inches, for the Length of the Main-Maſt.

The Length of the Main-Maſt being conſidered, the next Thing requiſite is to make the Diameter in the biggeſt Place ſuitable to it, or the Streſs it will bear. Which Proportion is alſo various, not only from the Bulk and Form of the Ship, but alſo from the Difference there is in the Strength of the Timber, and Nature of the Soil from which it is produced.

Let us ſuppoſe then three ſorts of Trees, one of *Riga*, another of *Gottenburgh*, and a third of *New-England*. A Maſt of 9 Inches Diameter of *Gottenburgh* Growth would be equal to one of 10 Inches and a half of *Riga* Growth, and thoſe two of ſuch a Bigneſs will be equal to a *New-England* Tree of 12 Inches Diameter. Not but that there may be a vaſt Difference between the Trees of each Country's Growth, not only from the Years they have ſtood, but alſo from the Soil where they grew.

It muſt be obſerved, that for every Yard in Length of a Main-Maſt for a Ship of the largeſt Size, there is an Inch allowed for the Diameter; for a middle Siz'd Ship ſeven-eights or ſix-ſevenths of an Inch; and for a ſmall one four-fifths or three-fourths of an Inch. But this is in ſome Meaſure to be proportioned to the Security the ſaid Maſts have by the Rigging.

FORE-MAST, TOP-MASTS.

The Fore maſt ought to be ſeven-eights or eight ninths of the Main-maſt; the Fore-top-maſt 3-fifths of the Fore-maſt; and the ſame Proportion muſt be obſerved between the Main-top-maſt and the Main-maſt.

MAIN-YARD, FORE-YARD, TOP-SAIL-YARDS, &c.

The Main-yard is ſeven-eights of the Main-maſt, the Fore-yard ſeven-eighths of the Main-yard, Top-ſail-yards five-ninths of the Main-yards reſpectively, the Top-gallant Yards half the Top-ſail Yards, and the Top-gallant-maſts half of the Top-maſts, or ſomething ſhorter.

BOWSPRIT, &c.

The Bowſprit ſhould be two-thirds of the Main-maſt for Length, or three-fourths of the Fore-maſt for ſmall Ships; and for Bigneſs, let it be nine-tenths, or more, of the Main-maſt. The Sprit-ſail Top-maſt is one-third of the Fore-top-maſt for Length, allowing three-fourths of an Inch in Diameter to every Yard in Length for the ſmalleſt of theſe Maſts or Yards, and not exceeding one Inch for the biggeſt.

MIZON-MAST.

The Mizon-maſt ought to be (in a third Rate) ſix-ſevenths of the Main-maſt, allowing two-thirds of an Inch Diameter for every Yard in Length. And this Length for the Mizon maſt is when it ſteps in the Hold, but if upon the Lower Gun-deck, then the two-thirds of the Main-maſt will be ſufficient: But in a ſmall Ship five ſixths of the Length of the Main-maſt will do for the Mizon-maſt, if it ſteps in the Hold.

MIZON-TOP-MAST.

The Mizon-top-maſt is one-third of the Mizon-maſt ſtept in Hold, allowing three-fourths of an Inch for Bigneſs to a Yard in Length.

MIZON-YARDS, *&c.*

The Mizon-yard is as long as the Fore-yard, allowing half an Inch in Bigneſs for a Yard in Length; Mizon-top ſail Yard one-third of the Mizon-yard, allowing three-fourths of an Inch for Bigneſs. The Croſs-jack Yard is ſomething longer than the Main-top-ſail Yard, allowing to every Yard in Length half an Inch in Diameter. The Sprit-ſail Yard is five-ſevenths of the Fore-yard, and Sprit-ſail Top-ſail Yard half the Sprit-ſail Yard.

It was the Practice of a very good Maſt-maker, to take the Length of the Lower Gun-deck, and the extreme Breadth, and adding them together, to take half that for the Length of the Main-maſt in Feet, *viz.*

Length on the Deck, from Rabbet to Rabbet — 150
Breadth extreme — — — — — — 40
190 Yd. Ft.
3) 95(31 : 2
2(

Whence this Maſt, according to the Cuſtom, is 32 Yards.

Therefore either by this Calculation, or that before given, may every three-maſted Ship's Main-maſt be proportioned.

A General PROPORTION for the RIGGING OF A THREE MAST SHIP.

For the BOWSPRIT.

HOrſe's Length ſix-ſevenths of the Bowſprit.

Circumference, one-ſeventh of the Diameter of ditto.

Dead-eyes for ditto, twice the Diameter of the Circumference of the Horſe.

Lanyard for ditto Length, one-third of the Horſe. Circumference half the Horſes.

Straps for ditto, equal in Bigneſs to the Horſe, and two-ſevenths of the Length.

Gammonings, Circumference, one-fifth of the Diameter of the Bowſprit, and 6 Times its Length.

Wooldings, half the Bigneſs of the Gammoning, and five-ſixths of the Length.

Bob-ſtay, two-thirds of the Length of the Bowſprit.

Sheets for the Sprit-ſail Cabled, Circumference 7-25ths of the Diameter of the Sprit-ſail Yard.

Length, ſeven Times as long as that Yard.

Two 2-round Blocks, 4 Times the Length of the Circumference of the Sheet.

Pendants Cabled, ſix-ſevenths of the Sheets for Bigneſs, and one-tenth of the Length.

Hallyards, equal in Bigneſs to the Sheets, and half the Length.

Lifts, equal in Bigneſs to the Pendants, and two-thirds of the Length of the Sheet.

Seizing to the Bow-ſprit, two-eights of the Bigneſs of the Lifts, and one fifth of the Length.

Standing Lifts, equal in Bigneſs to the Horſes of the Bow-ſprit, and alſo in Length.

Lanyards equal in Bigneſs to the Seizings, and half the Length.

Straps, three-fourths of the Bigneſs of the Standing Lifts, and one-third of the Length.

Braces, five-ſixths of the Lifts, and half as much longer.

Pendants, one-fifth bigger than the Braces, and one-twentieth of the Length.

Slings, twice as big in Circumference as the Braces, and one-fifteenth of the Length.

Seizing and Rackings, three-tenths of the Slings, and twice as long.

Horſes for the Yards, Circumference nine-twenty-fifths of the Diameter of the Yard, Lengths five-ſixths of the Yard.

Lanyards, one-third of the Horſes in Bigneſs, and five-ſixths of the Length.

Clew-lines, Circumference, 5-21 of the Diameter of the Sprit-ſail Yard, and 4 Times the Length of the Yard.

Bunt-lines, four-fifths of the Clew-lines in Bigneſs, and two-thirds of the Length.

Reef-lines, half the Circumference of the Bunt-lines, and 5 Times the Length of the Yard.

And after ſuch a Method may every individual Part of the Rigging be proportioned and calculated; but as it would be very troubleſome, I ſhall endeavour to abbreviate it, and make it ſomething eaſier. In the proſecution of which I ſhall obſerve this Method, only particularly to proportion the material Ropes, and bring all Lanyards, Pendants, Seizings, Straps for Blocks, Ratlings, Wormings, Runners of Tackles, and Tackle-falls, into a general Proportion as to their Bigneſs, ſhewing ſome Reaſons why it ſhould be ſo.

The Uſe of a Lanyard being to unite two other Parts together, as Stays and Shrouds, and ſeveral other Ropes that are very large, and cannot be ſo well joined together, otherwiſe than by the Help of ſmaller Ropes. I have obſerved it to be almoſt general, that the Lanyard is half the Circumference of the Ropes they ſecure, ſo that they are a quarter as ſtrong; that 4 ſuch Parts are equal to one Part of the great Rope, though it is uſual to have 6 Parts applied, as Lanyards to every Rope that they ſo ſecure, and yet very often the Lanyard is broke, and very ſeldom the Shroud, which muſt be certainly owing to the Motion of the Ship, when the Shrouds on one Side being ſtretched by the Weight of the Maſt, the Lanyards on the other Side grow ſlack, and by ſudden Jirks are fretted againſt the Wood in which they are reeved, and ſo broke; for otherwiſe, in a regular Strain, the ſix Parts of the Lanyards of half the Circumference of the Rope they ſecure muſt hold longeſt.

Wherefore ſince 6 Parts of a Lanyard of half the Circumference will be ſufficient to hold any ſuch Rope, there may be a general Proportion drawn, that where the Size of any Lanyard is required leſs in Proportion to the Rope they ſo ſecure, as in Stays and ſeveral other Ropes, there the Number of Turns will render the Lanyard equal in Strength to the 6 Parts of thoſe which are half the Circumference of the Rope; and for the Space between, allow for every Inch the Dead-eye is in Diameter 3 Inches and a quarter between each Dead-eye: And this is for Thwart-ſhips, but Fore and Aft they need not be ſo much, but in a cubical Proportion between the Length and Breadth of the Ship; for the Property in this Part is no otherwiſe to be conſidered than from the Motion of the Ship, ſince the ſhorter the Space, the better for the Lanyard, but the worſe for the Great Rope.

The Seizings may be one-ſixth of the Rope they ſeize, allowing ſuch a Number of Turns, as may be equal to double the Weight of a Cube or Die-ſquare, made by each reſpective Rope ſo ſeized.

Straps of Blocks are generally in two Parts, and ſometimes in four, which ought to be equal in Strength to the Folds of the Tackle-fall, or any other Rope: And ſince 4 Parts of any Rope of 6 Inches Circumference are near equal to 2 Parts of a Rope alike in Goodneſs, of 8 Inches and a half in Circumference, thoſe two Parts will be ſuitable for a Strap to a Block that is uſed with 4 Folds, as a Tackle-fall, or any other running Rope: From whence may be derived a general Proportion for ſtrapping every Block in a Ship, as to Bigneſs; but for the Length they are practically allowed to be three Times the Length of the Block, or ſomething more, it being altogether unreaſonable to confine the Workman or Rigger to an Inch of Rope: But it ought to be obſerved, that ſuch a Length will do, when the Block is only ſeized with an Eye; for if Blocks are to be put over a Yard, or the like, the Property will be altered.

Pendants, their Circumference may be conſidered from the preceding Rule of Strapping Blocks; but the Length is various according to their Uſe.

Ratlings are one-ſixth of the Shrouds: Wormings one-eighth of the Rope.

Pendants of the Main and Fore-maſt ought to be as big as the Shrouds, ſince they purchaſe a great Weight of Boats and Anchors.

The Runners are eleven-twelfths of the Pendants, and Tackle-falls half the Circumference of the Pendants.

But before I proceed any farther, I ſhall ſet down a few Abbreviations to contract a little the remaining Part, obſerving that all Rope is ſized as to its Bigneſs by the Circumference, which in every Article ſhall be firſt mentioned.

Cir. — — — *Circumference.*
Di. — — — *Diameter.*
Le. — — — *Length.*
D°. — — — *The ſame.*

For the SPRIT-SAIL TOP-MAST.

SHrouds, Cir. two-fifths of the Di. of the Sprit-ſail Top-maſt in the Cap Le. two-thirds of the Top-maſts Length.

Pendants of Back-ſtays, or Crane-line, as ſome call it, as big as the Shrouds, and one-fifth of the Length.

Falls of the Pendants, half the Pendant, and 6 times as long.

Tie of the Hallyards, as big as the Shrouds.

Hallyards, one-fourth of the Tie, and three times as long as the Top-maſt. Le. of the Tie one-third of the Hallyards.

Lifts, as big as the Hallyards, and twice as long.

Braces, two-thirds of the Lifts, and twice as long.

Pendants of Braces, as big as the Lifts, and one-tenth of the Le. of the Brace.

Parrel Rope, as big as the Pendants of the Brace, and for every Inch the Maſt is through in the Cap, allow 2 Feet for the Le. of the Parrel-rope.

Clew-lines, as big as the Lifts, and 5 Times as long as the Hallyards.

For the FORE-MAST.

PEndants of Tackles, Cir. two-ſevenths of the Di. of the Fore-maſt in the Partners, and for every Inch in Circumference allow one Fathom for Length.

Runners of the Tackle, eleven-twelfths of the Pendant, and 4 Times the Length.

Tackle Falls, half the Pendants, and 9 Times the Length.

Shrouds, Cir. as big as the Pendants, and eight-elevenths of the Le. of the Fore-maſt.

Lanyards as before, Ratlings D°. Wormings D°.

Cap-harping Legs and Falls equal in Bigneſs, being one quarter of the Shrouds. Length twice that of the Fore-yard.

Fore Stays, Cir. half the Di. of the Fore-maſt, and eight-ninths of the Length.

Lanyards, ſeven-twentieth of the Stay, by reaſon this Lanyard's Strength is made up by the Number of Tuns extraordinary.

It may alſo be obſerv'd, that the Le. of the Lanyard for the Stay, to the Le. of each Lanyard for the Shroud, is as 2 to 1.

Worming the ſame as before.

Collar of the Stay, nine-tenths in bigneſs to the Stay, and one-quarter of the Length.

Woolding of the Maſt, for every Inch the Maſt is in Di. at the Partners, allow one-eighth for the Cir. of Woolding; and for the Le. allow 8 times the Le. of the Maſt.

Crow-feet for the Top, as big as the Ratling, and as long as the Cat harpings. Tackle for Do. equal in Bigneſs, and one-ſeventh of the Length.

Jeers, five-ſixths of the Shrouds, and 6 times the Length of the Yard.

Laſhers for the Yards as big as the Lanyards of the Shrouds, and twice as long as the Stay.

Tackles for Boats, as big as the Woolding, and half as long as the Falls of the Runner.

Lifts, half the Shrouds for bigneſs, and four times as long as the Fore-maſt.

Straps for the Cap, as big as the Lifts, and as long as the Collar of the Stay.

Braces, as big as the Lifts, and within two fiftieth Parts as long.

Pendants, as big as the Braces, and one-tenth as long. Which may be a general Rule for the Length of the Pendants of the Braces.

Parrel Rope, Circumference one-ſixth of the Diameter of the Maſt in the Partners. And for every Inch the Maſt is there, allow three Feet for Length.

Nave line, as big as the Cat harpings, and as long.

Racking and ſeizing for the Parrel, two-thirds of the Nave-line, and four-fifths of the Length.

Horſes for the Yard-worn Rope, nine-tenths of the Jeers for Bigneſs, and ten-elevenths of the Yard for Length.

Lanyards, two-thirds as big, and half as long.

Puddening for the Yard, as big as the Jeers, and 12 Ci. of the Yard in the Slings.

Fore Sheets, as big as the Jeers, and five Times the Length of the Fore Maſt.

Stoppers, as big as the Fore Sheets, and one-twentieth of the Length.

Lanyards, as big as the Worming of the Shrouds and two thirds of the Length of Stoppers.

Fore Tacks, as big as the Sheets, but taper'd, and half as long.

Bow-lines, as big as the Braces, and ſeven-eights of the Length.

Laſhers, five-ſixths of the Bow-lines, and one-ſeventh of the Length.

Bow-line Bridles, as big as the Bow-lines, and one-tenth of the Length.

Clew-garnets, as big as the Braces, and as long.

Bunt-lines, two-thirds of the Clew garnets, and as long as the Jeers.

Leech-lines, as big as the Bunt-lines, and half as long.

Reef-lines, half the Leech-lines, and four Times the Length of the Yard.

Rope-bands and Ear-rings, three-fourths of the Leech-lines, and ſeven Times as long as the Yard.

For the FORE-TOP-MAST.

SHrouds, Cir. one-third of the Diameter of the Top maſt, and thirteen-fourteenths of the Length.

Lanyards, as aforeſaid, Ratlings Ditto.

Pendants of the Top-rope, as big as the Fore Shrouds, and as long as the Fore Yard.

Falls of the Top-rope, ſeven-twelfths of the Pendants, and five Times as long as the Fore Top-maſt.

Pendants of Burton-Tackles, Cir. one Quarter of the Diameter of the Top-maſt, and two-thirds of the Length.

Burton Falls, two-thirds of the Pendants, and ſeven Times the Length.

Puttock-ſhrouds, as big as the Top-rope Fall, and two-thirds of the Length altogether.

Standing Back-ſtay, as big as the Shrouds, and nine-thirteenths of the Length of the Fore-maſt and Fore Top-maſt put together: Each of them to have ſtanding Backſtays.

Lanyards as aforeſaid.

Stays Cir. nine twenty-fifths of the Diameter of the Fore Top-maſt, and as long as the Back-ſtays.

Lanyards as aforeſaid.

Runner, as big as the Stay, and twice as long as the Fore Top-maſt.

Top-ſail Hallyards, five-ninths of the Runner, and twice the Length, and half the Length of the Top-maſt more.

Lifts, as big as the Hallyards, and 4 times the Le. of the Stay.

Beckets upon the Cap, as big as the Lifts, and one Quarter the Length of the Pendants of the Burton.

Slings, worn Rope, as big as the Puttock-ſhrouds, and ſix Times as long as the Beckets.

Parrel Rope, Cir. one Quarter of the Diameter of the Top-maſt in the Cap. And for Length allow three Feet for every Inch in Top-maſt is in the Cap.

Racking, one quarter of the Parrel Rope, and one ſixth longer.

Horſes for the Yard, worn Rope, as big as the Parrel Rope, and eighteen-nineteenths of the Le. of the Yard for Length

Top-ſail Sheets, Cir. one-third of the Diam. of the Fore Yard in the Slings, and twice the Length of the Fore Yard each.

Span worn two-fifths of the Sheet, and one-ſeventh of the Length.

Laſhers, as big as the Racking, and half as long as the Lanyard of the Stay.

Bow-lines, Cir. two thirds of the Fore Bow-lines, and as long as the Top ſail Hallyards.

Bridles, as big as the Bow lines, and two-ſevenths of the Length.

Clew-lines, as big as the Top-ſail Hallyards, and eight Times the Length of the Fore-top-maſt, and half its Length.

Bunt-Lines, as big as the Bow-lines, and half as long as the Clew-lines.

Reef-tackle { Tye, as big as the Clew-lines, and half as long as the Bow line Bridles.
Fall, three fifths of the Tye, and one-third of the Length of the Bow-lines.

Leech-lines, as big as the Bunt-lines, and as long as the Reef-tackle Fall.

Braces, as big as the Clew-lines, and three-quarters of the Length.

Pendants of Braces, as big as the Braces, and one-ſixteenth of the Length.

Stay-ſail Stay, worn ſeven ninths of the Stay, and three ſevenths of the Length.

Cringles worn, as big as the Lanyards, and half the Length of the Falſe Stay together.

Lanyards, two-ſevenths of the Stay, and half the Length.

Hallyards, as big as the Reef-tackle Fall, and three Times the Length of the Stay.

Sheet, as big as the Hallyards, and two-thirds of the Length.

Tack, one-third bigger than the Sheets, and one-fifth of the Length.

Reef-lines, half as big as the Sheet of the Stay-ſail, and ſix Times as long as the Fore Top-ſail Yard.

Rope-bands and Ear-rings, one-third bigger than the Reef-lines, and one-ninth longer together.

For the TOP-GALLANT-MAST.

SHrouds, Cir. two-fifths of the Diameter of the Maſt, and twelve-thirteens of the Maſt's Length.

Lanyards, as aforeſaid.

Puttock Shrouds, as big as the Top-gallant Shrouds, and half of the Length.

Stay, three-quarters of the Bigneſs of the Shrouds, and twice as long as the Fore Top-maſt.

Tye of the Hallyards, as big as the Shrouds, and five-ſixths of the Length of one Shroud.

Hallyards, three-quarters of the Tye, and as long as the Fore Maſt, Top Maſt, Top-gallant Maſt, and Stump of Dº. put together in their extreme Lengths.

Lifts, half the Shrouds, and two-thirds of the Hallyard's Length together,

Braces, as big as the Lifts, and three Times the Length of the Stay.

Pendants, as big as the Braces, and one eleventh of the Le.

Parrel Rope, as big as the Pendants. Le. two Feet and a half for every Inch the Top-gallant Maſt is in the Cap.

Bow-lines, as big as the Braces, and three-quarters of the Length.

Bridles, as big as the Bow-lines, and one-quarter of the Length.

Clew-lines, as big as the Hallyards, and as long as the Braces.

For the MAIN MAST.

PEndants of the Tackles, Cir. ſix twenty-ſeconds of the Di. of the Main Maſt in the Partners. Length half the Length of the Maſt.

Runners, twelve thirteenths of the Pendants, and as long as the Fore-runners.

Tackle-falls, ſeven-thirteenths of the Pendants, and eight Times the Length.

Pendant of the Garnet, five-ſixths of the Runners of the Tackle, and eleven twenty-fourths of the Length.

Guy of the Garnet, four-fifths of the Pendant, and two-thirds of the Length.

Garnet Fall, as big as the Main Tackle Fall, and half the Length.

Shrouds, as big as the Pendants, and five-ſevenths of the Length of the Main Maſt.

Lanyards, as aforeſaid. Rattling, ditto. Worming, ditto.

Cat-harpings, Legs and Falls, twice as big as the Worming, and twice as long as the Main Yard,

Stay, Cir. half the Di. of the Maſt, and 20-21 of the Maſt's Le.

Lanyard, 5-24ths for bigneſs of the Stay, and two-thirds of the Le.

Laſher to the Fore Maſt, half the Lanyard, and three-fifths of the Length.

Worming, one-ſixth of the Stay, and five Times as long.

Collar, three-quarters of the Stay for Bigneſs, and ſeven-ſixteenths of the Length.

Woulding of the Maſt, for every Inch the Maſt is in Di. at the Partners, allow one-ninth of an Inch for the Cir. of the Rope, and nine Times the Length of the Main Maſt for Length.

Crow foot for the Top, as big as the Worming, and as long as the Cat-harpings.

Tackle for D°. equal in Bigneſs, and one-eighth of the Length.

Jeers, eleven-thirteenths of the Shrouds, and eight Times the Length of each Shroud, ſo that each Jeer is four Times the Length of each Shroud.

Laſhers to the Yard, ſix-elevenths of the Jeers, and four-ſevenths of the Length of one Jeer.

Tackles for the Boats, five-ſevenths of the Main Tackle, and as long as the Garnet.

Lifts, as big as the Main tackle Falls, and twice as long as the Main Maſt and Yard put together, with two-fifths of the Length of the Main Yard added to them.

Strap for the Cap, as big as the Lanyards for the Shrouds, and five Times as long as the Cap.

Braces, ſix-ſevenths of the Lifts, and five Times the Length of the Main Yard.

Pendants, as big as the Braces, and one-tenth of the Length.

Parrel Rope, Cir. one-ſixth of the Di. of the Maſt; and for every Inch the Maſt is, allow 3 Feet for Length, as aforeſaid.

Nave-line, three-quarters of the Cat-harpings, or of equal Size and Length.

Racking and Seizing, one quarter of the Parrel, and half as long again.

Horſes for the Yard, worn Rope, nine-elevenths of the Jeers, and twenty-twenty-one of the Length of the Main Yard.

Lanyard, half the Horſe, and one-third of the Length.

Puddening to the Yard, as big as the Jeers, worn Rope, and 12 Cir. of the Yard in the Slings.

Sheet Cabled, as big as the Runners of the Main Tackle, and one-fifteenth longer than the Braces.

Stoppers, eight-ſixths of the Sheets, and one-twenty-one of the Length.

Lanyards, half the Nave-line, and two-thirds of the Stoppers for Length.

Tacks tapered, as big as the Shrouds, and half the Length of the Braces.

Luff Tackles, ſix-thirteenths of the Tacks, and ſeven-eighths of the Length.

Bow-lines, as big as the Lifts, and one-fifth longer than the Tacks.

Bridles, ſix-ſevenths of the Bow-lines, and two-ſevenths of the Length.

Tackle, five-ſixths of the Bridles, and of equal Length.

Clew-garnets, five-ſixths of the Braces, and five-ſixths of the Length.

Bunt-lines, two-fifths of the Clew-garnets, and half as long again.

Leech-lines, as big as the Bunt-lines, and half as long.

Stay-ſail Stay, one-third of the Main-ſtay, and three-quarters of the Length.

Lanyard, as aforeſaid.

Cringles worn, five-eights of the Stay, and as long as the Lanyards together.

Hallyards, half the Stay, and twice as long.

Sheet, five-eights of the Stay, and one-third of the Length.

Tack, three-quarters of the Stay, and half the Le. of the Sheet.

Studding-ſail Hallyards, as big as the Stay-ſail Tack, and 3 Times the Le. of the Main-maſt, one quarter the Le. added to it.

Sheet, five ſixths of the Hallyards, and one-quarter the Length.

Tack, as big as the Hallyards, and half the Length.

Reef-lines, three-quarters of the Leech-lines, and four Times the Length Main Yard, and two-thirds.

Rope-bands and Ear-rings, as big as the Reef-lines, and half as much longer, taken altogether.

For

For the MAIN TOP-MAST.

SHrouds, Cir. nine twenty-ninths of the Diam. of the Top-maſt in the Cap, and ſixteen-ſeventeenths of the Length of the Top-maſt.

Lanyards, as before

Ratling, two-ninths of the Shrouds, and fifteen-ſixteenths for Length of all the Shrouds.

Pendant of the Top-rope, Cir. ſix twenty-ninths of the Di. of the Top-Maſt. For Le. 12 thirteenths of the Main-Maſt.

Top-rope Fall, two-thirds of the Pendant, and three times the Length.

Pendants of Burtons, ſeven-ninths of the Shrouds, and half as long as the Pendants of the Top-rope.

Fall, four-ſevenths of the Pendants, and 6 times as long.

Puttock Shrouds, eight-ninths of the Top-maſt Shrouds, two-fifths of the Length.

Standing Back-ſtays, as big as the Shrouds, and nine-thirteenths of the Main Maſt and Main Top-maſt put together, for all of them.

Lanyards, as aforeſaid.

Stay Cabl'd, as big as the Shrouds, and ſix-ſevenths of the Le. of the Main Maſt and Main Top-maſt put together.

Runners of the Top-ſail Hallyards, Cir. half the Di. of the Top-ſail Yard, and twice as long as the Main Top-maſt.

Hallyards, three-fifths of the Runner, and twice the Length with the Length of the Main Top-maſt added to it.

Lifts, half the Runner, and eight times the Length of the Main Top-ſail Yard.

Beckets at the Cap, as big as the Lifts, and ſix times the Length of the Cap.

Braces, as big as the Lifts, and thirteen-fourteenths of the Le.

Pendants, as big as the Braces, and one-tenth of the Length.

Beckets about the Mizon-Maſt, as big as the Main Top-ſail Hallyards, and as long as the Beckets at the Main Top-maſt Cap.

Slings, worn Rope, as big as the Mizon Beckets, and four times the Length.

Parrel Rope, Cir. one quarter of the Di. of the Top-maſt in the Cap; and for Length allow 3 Feet to an Inch, as aforeſaid.

Racking, one quarter of the Parrel, and as long as the Slings.

Horſes for the Yard worn, as big as the Parrel Rope, and eighteen-nineteenths of the Yard for Length.

Sheets, Cir. half the Diameter of the Top-ſail Yard, and ſix-ſevenths of the Length of the Braces.

Span, worn Rope, half the Sheets, and one-fifteenth of the Le.

Laſhers, three quarters of the Ratling, and one-third longer than the Length of the Span.

Bow-lines, as big as the Hallyards, and fourteen-fifteenths of the Length.

Bridles, as big as the Bow lines, and five-fourteenths of the Length

Clew-lines, as big as the Bow-lines, and eight times as long as the Main Top-maſt, and half as long.

Bunt-lines, two-thirds of the Clew-lines, and half as long.

Leech-lines, as big as the Bunt-lines, and ſeven-ſeventeenths of the Le.

Reef Tackle Tyes, as big as the Braces, and as long as the Pendants of the Braces.

Fall, three-fifths of the Tye, and three times as long.

Stay-ſail Stay, worn, one-ninth of the Stay, and two-fifths of the Length.

Lanyards, as aforeſaid.

Cringles worn, four-ſevenths of the Stay, and as long as the Lanyards together.

Hallyards, as big as the Reef Tackle Fall, and twice as long as the Stay.

Sheet, as big as the Hallyards, and five-ſixths of the Length.

Tack, as big as the Leech-lines, and one third of the Lanyard.

Studding-ſail Hallyards, as big as the Stay-ſail Stay, and 4 times as long as the Main Top-maſt, and three quarters of the Length of the Top-maſt added to it.

Sheet, four-fifths of the Hallyards, and one-ſeventh of the Le.

Tack, as big as the Sheet, and one quarter of the Length.

Reef-lines, half as big as the Leech-lines, and four times the Length of the Main Top ſail Yard, with one-third of the Le. added unto it.

Rope-bands and Ear-rings, as big as the Reef-lines, and half as long, put together.

For the MAIN TOP-GALLANT MAST.

SHROUDS, five-ninths of the Top-maſt Shrouds, and twelve-thirteenths of the Top gallant Maſts Length.

Lanyards, as before.

Puttock Shrouds, as big as the Top-gallant Shrouds, and half of the Length.

Stay, three-quarters of the Shrouds, and twice the Le. of the Top-maſt and one-eighth of the Length.

Tye of the Hallyards, as big as the Shrouds, and one-ſixth of the Le. of the Stay.

Hallyards, three-fifths of the Tye, and twice as long as the Main maſt.

Lifts, as big as the Hallyards, and eight-ninths of the Stays Length together.

Braces, two-thirds of the Lifts, and three Times the Length.

Pendants as big as the Braces, and one-twelfth of the Length.

Parrel-rope, as big as the Pendants, allowing 2 Feet in Length for every Inch the Top-gallant Maſt is in the Cap.

Bow-lines, as big as the Lifts, and the Length of the Braces.

Bridles, as big as the Bow-lines, and one-twelfth of the Length.

Clew-lines, as big as the Bow-lines, and twice as long as the Hallyards.

For the MIZON-MAST.

SHROUDS, Cir. 9-20ths of the Dia. of the Mizon-maſt in the Partners. Len. two-thirds of the Maſt, if it ſteps in the Hold, and eight-ninths if on the lower Deck.

Lanyards, as before. Ratling D°

Pendants, ſeven-ninths of the Shrouds Len. two-thirds of one Shroud.

Fall, five-ſevenths of the Pendants, and 7 Times the Length.

Stay, as big as the Shrouds, and as long as the Maſt, if it ſteps in Hold.

Lanyards, as before.

Collar, eight-ninths of the Stay, and five-ſixths of the Length.

Crow-foot for the Top, one-eighth of the Shrouds, and as long as the Stay.

Tackle for ditto, as big, and one quarter of the Length.

Jeer, eight-ninths of the Shrouds. Length twice that of the Mizon-maſt, if it ſteps in Hold, and half that Length more.

Laſher, five-eights of the Jeers, and one-fifth of the Length.

Parrel-rope, as big as the Laſhers, and for Length allow 2 Feet as aforeſaid.

Truſs, as big as the Parrel-rope, and twice as long as the Mizon-maſt ſtept on the Deck.

Slings, as big as the Shrouds, and as long as one Shroud.

Sheet, ſeven-ninths of the Shrouds, and as long as the Truſs.

Tack, five ſevenths of the Sheet, and one-ſixth of the Length.

Bow-lines; as big as the Tack, and as long as the Slings put together.

Middle Brails, Main Brails and Peek Brails } one-fifth of the Bow-lines for Bigneſs, and for Len. 6 Times the Len. of the Mizon-maſt ſtept in Hold, and ¼ of ſuch a Length added to it.

Lacing for the Mizon, half the Brails, and 3 Times as long as the Mizon-yard, and one-third of the Length.

Stay-ſail Hallyards, as big as the Brails, and as long as the Sheet.

D° Sheet, as big as the Mizon-tack, and half the Len. of D° Bow lines.

Tack, four-fifths of the Sheet, and three-quarters of the Len. of D°.

For the CROSS-JACK YARDS.

STanding Lifts, as big as the Mizon Bow-lines, and three-quarters of the Length.

Lanyards, three-fifths of the Lifts, and two-thirds of the Length.

Braces, three-fifths of the Lifts, and ſix Times the Length.

Pendants, four-fifths of the Lifts for Bigneſs, and one-fifteenth of the Length of the Braces.

Slings, as big as the Mizon Sheet, and two-thirds the Length of the ſtanding Lifts.

For the MIZON TOP-MAST.

SHrouds, as big as the Main Top-gallant Maſts, and as long as the Mizon Top-maſt.

Lanyards, as before.

Puttock Shrouds, as big as the Top-gallant Maſt Shrouds, and as long as the Lanyards.

Stay, as big as the Shrouds, and twice the Le. of the Top-maſt Lanyards, as before.

Tye, as big as the Stay, and ſeven-eighths of the Len. of the Top-maſt.

Hallyards, four-fifths of the Tye, and twice the Len. of the Mizon Top-maſt ſtept on the Deck.

Lifts, three-fifths of the Shrouds, and 5 Times the Len. of the Mizon Top-maſt, both together.

Braces, as big as the Lifts, and 8 Times the Len. of the Top-maſt, and half that Length.

Pendants, as big as the Braces, and one-fourteenth of the Length.

Parrel-Rope, as big as the Pendants, allowing two Feet in Len. for every Inch the Maſt is in the Cap.

Sheets, as big as the Shrouds, and 16-17ths of the Braces for Le.

Bow-lines, two-fifths of the Sheets, and equal in Length.

Bridles, as big as the Bow-lines, and one-ſixth of the Length.

Clew-lines, as big as the Braces, and as long as the Bow-lines.

Other

Other neceſſary ROPES.

VIol cabled, as big as the Fore-ſtay, and the Len. of the Gun-deck, and five-thirteenths of that Length.

Straps, ſeven-tenths of the Viol, and one-fifth that Length.

Laſhers, half the Straps, and twice their Length.

Pendant of the Winding-tackle, four-fifths of the Viol, and four-fifths the Length of the Main-maſt.

Fall of D°. half the Viol, and 3 Times the Length of the Pendant.

Pendant of the Fiſh-tackle, 13-16ths of the Pendant of the Winding-tackle, and one-third of the Length of the Gun-deck.

Fall of D°. ſeven-thirteenths of the Pendant, and 4 Times as long.

Cat-ropes, nine thirteenths of the Pendants of the Fiſh tackle, and 7 Times the Breadth of the Ship, both of them together for Length.

Lanyards, as aforeſaid.

Stoppers of Anchors, 11-13ths of the Pendant of the Fiſh-tackle, and each of equal Le. to the Pendant.

Shank-painters, as big, and five-ſevenths of the Length.

Stoppers at the Bit, four-fifths of the Viol for Bigneſs, and near 3 Feet long.

Seizings, one-twelfth of the Stoppers, allowing 2 Fathoms and a half to one Fathom of the Stoppers for Length.

Lanyards, three-eights of the Stoppers, and ſix-tenths of the Length of the Seizings.

Buoy-ropes cabled, as big as the Pendant of the Fiſh-tackle, and each as long as the Cat-rope ſingle.

Buoy-ſlings, ſeven-thirteenths of the Buoy-ropes for Bigneſs.

Gun ſlings, ſeven-eights of the Winding Tackle Pendants for Bigneſs.

Butt-ſlings, ſix-ſevenths of the Gun D°.

Hogſhead-ſlings, four-ſixths of the Butts.

Nut-ſlings of the Guns, three-fourths of the Hogſheads.

Horſes in the Head, worn, ſeven-elevenths of the Gammoning, and 5 Times the Length of the Head, on a middle Line, from the Stem to the Fore-part of the Lion, both.

Lanyards, as aforeſaid.

Poop Ladders, worn, as big as the Mizon-Jeers, and 7 Times the Ship's Draught of Water abaft for Length both of them.

Middle Rope, one-third of the Sides, and ſeven-ninths of the Length.

Laſher, two-thirds of the middle Rope, and four-ſevenths of the Length.

Puttock-ſtaves, as big as the Mizon Shrouds.

Cable bends, five-elevenths of the Shank-painters, or Stoppers, for Bigneſs.

Entering ropes, generally 3 Inch Rope.

Port Ropes, for every 6 Inches the the Port is Square, allowing half an Inch for the Circumference of the Rope.

Puddening of Anchors, as big as Cable-bends.

Seizings, one-quarter of the Puddenings.

For the LONG-BOAT.

MAin Stay, as big as the Mizon Top-maſt Shrouds.

Tye D°. Hallyards, three-fifths of D°.

Pendants of Burton, one-fifth more than the Stay. Fall two thirds of the Tye.

Fore Sheets, half the Burton-fall. Hallyards D°.

Main Sheet, as big as the Burton fall. Tack D°.

Boat-rope cabled, as big as the Buoy-ropes, and for Length let it be the Length of the Ship aloft, extreme.

Gueſt Rope, ſeven-thirteenths of the Boat Rope, and one-third longer.

Painter, half the Boat Rope, and one-fifth of the Length.

Yard-Rope, half the Hallyards, and twice the Length of the Main-ſtay.

For the PINNACE.

MAin Sheet, as big as the Long-boat's Fore Sheets.

Fore Sheets, ſeven-eighths of the Main Sheets.

Boat Rope cabled, eight-elevenths of the Long-boat's Rope for Bigneſs, and as long as the Gueſt Rope.

Gueſt Rope, ſeven-eighths of the Boat Rope, and ſeven-eighths of the Length.

Painter, five-ſevenths of the Gueſt Rope, one-ſixth of the Length.

The ſeveral Sizes of STRAPPINGS and SEIZINGS.

Inch.		
6	Rope	4 Times the Length of one Main Shroud, or 40 fathoms.
5½		½ that Length of the 6 Inches.
5		¾ of the 6 Inches.
4½		As much as of 6 Inches.
4		D°.
3½		D°.
3		D°.
2½		¼ as much more of this than of 3 Inch.
2		D°.
1½		As much as of 6 Inches.

And this is ſufficient to Strap every Block belonging to all the Rigging.

SEIZINGS.

Inch.		
2	Rope	As much as of the 5 Inch Strapping in Fath.
1½		⅔ of the two Inch.
1		11 Times as much as of 1 Inch and ½.
¾		D°.

Spun Yarn, for every Inch the Main Stay is in Dia. allow 5Hund.Weight.

To every Hundred Weight of Spun Yarn allow 3 tarred Lines.

To every tarred Line allow three quarters of a Pound of tarred Marline.

To every 30 tarred Lines allow one White Line.

To every White Line allow one Pound and a half of White Marline.

To every Hundred Weight of Spun Yarn allow 8 Yards and a half of old Canvas.

To every 8 Hundred Weight of Spun Yarn allow half a Barrel of Tar.

For every Yard the Main Maſt meaſures on the Superficies that's paid with Roſin, allow one Pound three-quarters of Roſin to pay all the Maſts.

To every Pound of Roſin allow one Pound and two-thirds of a Pound of Tallow.

For every 15 Pounds of Roſin allow one Gallon of Oil.

To every Gallon of Oil allow 2 Barrels of Blacking, which is for the Maſts Heads and Yards to pay them.

For every Fathom of Woolding allow 5 Nails.

To every 300 of Nails allow one Leather Bucket.

To every White Line allow 2 Pounds and a half of Twine, and two Log-lines.

To every Main Shroud allow 3 Trucks for the whole Rigging.

To every Barrel of Tar allow one Bruſh.

And for every four Barrels of Blacking one Bruſh.

A TABLE *of the Thickneſs of all* ROPES *belonging to any* SHIP, *from a Maſt of* 12 *Inches to* 34 *Inches through.*

The USE of the TABLE.

FIND the Diameter of the Main-maſt at the Top of the *Column*, and under that, and againſt the *Name of the Rope*, you have the *Thickneſs* of the ſaid Rope.

EXAMPLE:

Suppoſe in a Ship whoſe Main-maſt is 30 Inches through, and I deſire to know the *Thickneſs* of the Main-ſtay: I look for the *Maſt of* 30 *Inch.* at the Top of the Table Page, and under it, againſt (Stay) I find 15, which ſhews, that a Ship whoſe Main-maſt is 30 Inches through, or in Diameter, requires a Main-ſtay of 15 Inches.

Again: If the Fore-top-gallant Stay of the ſame Ship is required, look for *the Bigneſs of the Fore-top-gallant Rigging*; you will, under 30, the Diameter of the Main-maſt, find 2 Inches the *Thickneſs* of the Fore-top-gallant Stay; and ſo in all others.

The

The Bigneſs of the Rigging of theſe Main-Maſts, and Main-Top-Maſts. *The Fore-Maſt to theſe Maſts followeth in the next Page.*	Maſt of 34 In. 1 In	Maſt of 32 In. 2 In	Maſt of 30 In. 3 In	Maſt of 29 In. 4 In	Maſt of 28 In. 5 In	Maſt of 27 In. 6 In	Maſt of 26 In. 7 In	Maſt of 24 In. 8 In	Maſt of 23 In. 9 In	Maſt of 19 In. 10 In	Maſt of 13 In. 11 In	Maſt of 12 In. 12 In
Pendant of Tackles	8½	8	7	6½	6½	5½	5	7	6	5	4	4
Runners	6	5½	5	5	4½	4	3½	5	5	4½	3½	3½
Falls of the Tackles	4	4	3½	3½	3	3	3	3½	3½	2½	2½	
Shrouds	8½	8	7½	7	6½	5	5	7	6	5	4	4
Lanyards	4½	4	4	3½	3	3	3	4	3½	3¼	2½	2½
Swifters	8½	8	7½	7	6½	5	5	5½	5	4½	3½	
Lanyards	4½	4	4	3½	3½	3	2½	3½	3	3	2½	
Stay	17	16	15	14½	14	10	8	12	11½	9½	6½	6
Collar at the Stem	16	15	13	12	11	9	8	10	10	8	6	
Lanyard of the Stay	6	5½	5½	5	4	4	3½	4	4	3½	2½	3
Lifts	4½	4	3½	3½	3	3	2½	3	3	2½	2½	2
Tacks	9½	9	8½	8	6½	6	5	6½	6	5½	4	4
Sheets	6½	6½	6	6	5	4½	4	4½	4½	3½	2½	3
Bow-lines	5½	5	4½	4½	4	4	3	3	3	2½	2½	
Bridles	4½	4½	4	4	3½	3½	3	3	3	2½	2	2½
Pendants Fore-braces	4	4	3¾	3½	3	3	2¾	3	3	2½	2	2½
Braces	3	3	3	3	2½	2½	2	2½	2½		1½	2
Clew-garnets	4	3½	3	3	2½	2½	2	3	2½	2½	1½	2
Jeers	8½	8	7	6	5½	5		6	4½	4		
Parrel rope	6	6	5	5	4½	4	3	[illegible]½	3	3½	3	3
Breaſt-Rope	8	7	6	6	6							
Runner of Mart-lines	2½	2½	2½	2½	2	2						
Fall of Mart-lines	3	2¼	2¼	2	2	2		2½	2	2	1½	
Pendant of the Garnet	8½	8	7½	7	6	5	4½	6	5½	5	5	4
Tye	6	5½	5	5	4½	4	3½	3½	3½	3	3	3
Fall of the Garnet	4½	4	4	4	3½	3½	3	3	3	2¼	2	2
Main-top-maſt Rigging	1	2	3	4	5	6	7	8	9	10	11	12
Pendant of Tackles	5	5	4½	4	3½	3	2¾	3½	3½	2½		2
Falls of Tackles	2½	2½	2½	2½	2	2	1½	2	2	1½		1½
Shrouds	5	5	1¼	4	4	3	3	4	3½	3	2¾	2½
Lanyards	2½	2½	2¼	2	2	2	1½	2	2	1½	1	1
Back-ſtays	5	5	5	4	3½	3	2½	4	4	3½	2	2½
Lanyards	3	3	3	2½	2½	2	2	2½	2	1½	1	1
Stay	8	7	6	5	5	4½	4	5	4½	3½	3	2½
Lanyard	4	4	3	3½	3	3	2¾	3	2½	2	1½	2
Lifts	2½	3	2½	2½	2	2	2¾	2	2	1½	1	1

Note, Their Bunt-lines are in Bigneſs as followeth,

3½ 3½ 3 2½
2 2 2 2
2 2 2 2½

Note, The Ships that have no Jeers their Tye is 4 Inches, and their Hall-yards is 2½.

The

The Bigneſs of the Fore Rigging.	1	2	3	4	5	6	7	8	9	10	11	12
Pendants of Tackles	8	7½	7	6	5	5	5	6¼	5½	4½	3½	16
Runners of Tackles	5½	5	5	5	4	4	4	5	5	4½	3	2½
The Falls	4	3½	3½	3½	3	3	3	3½	3	2½	2	
Shrouds	8	7½	6½	6	5½	5	4½	6	5½	4½	3½	3½
Lanyards	4	4	4	4	3½	2½	2	3½	3½	3	2	2
Swifters	8	7½	7	6	5½	5	4½					
Lanyards	4	4	4	4	3½	3½	3					
Stay	15	13	12	11	9	7	6½	10½	8½	7½	5	4
Lanyard	5	5	5	4½	4	3½	3	4	3½	3	2	2
Tye	8	7½	7	7	6	6	5	5½	5	5	3½	4
Hallyards	6	6	6	5	4½	3½	3	3	3½	3	2	2
Jeers	6½	6	6	6	4	4	5½					
Lifts	4	3½	3½	3	3	2½	2	3	3	2½		2
Parrel-ropes	5	5	4½	4½	4	4	3	3	3	2½	2	2½
Breaſt-ropes	8	7	6	6½	5							
Sheets	6	6	5	5	4½	4	3½	4½	4	3½	2½	2½
Jacks	8½	8	7	7	6	5	4½	6	6	5	5	3½
Bow-lines	4½	4½	4	3½	3½	3	3	3¼	3	2½	2	2½
Bridles	4½	4	3½	3	3	3	2	3½	3	2½	2	2
Pendants of Braces	4	3½	3	3	2½	2½	2½	3	3	2½	1½	2
Braces	3	3	2½	2½	2	2	2	2½	2½	2	1¼	1½
Clew-garnets	3½	3	3	2½	2	2	2	3	2½	2	1½	1½
Bunt-lines	3	3	2½	2½	2	2	2	2	2	2	1½	1½
Mart-line Runners	3	2½	2½	2½	2							
Mart lines	2½	2½	2½	2½	2	2½	2	2	1½			

The Bigneſs of the Fore-top-ſail Rigging.	1	2	3	4	5	6	7	8	9	10	11	12
Pendants of Tackles	4½	4	3	3	2½	½	3½	3½	3	2½		
Falls to them	2½	2	2	2	1½	½	2	2	2	1½		
Shrouds	4½	4	3½	3½	3	3	2½	4	3	3½	2	2
Lanyards	2	2	2	2	1½	1½	2	2	1½	1	1	1
Puttocks	5	4½	4½	4	3½	3	2¾	3	3	2½	1½	
Stay	5	5	5½	4½	4	3	3	4½	4	3½	2	2½
Pendant of the Lanyard	4	3½	3	3	2½	2½	1¾					1½
Fall of the Lanyard	3½	3½	3	2½	2	2	2	3	2½	2	1½	1½
Tye	7	7	6½	6½	5½	5	5	6	5	3½	2	
Runner	5	5	4¾	4¾	4	4	4	4½	4	3½		
Hallyards	5	4½	4	4	3½	3½	2¾	3	2½	2	1½	
Bow-lines	4	3½	3	3	2½	2½	2½	2	2	1½	1¾	
Bridles	3½	3½	3	3	2½	2	1½	2	1½	1½	1½	
Clew-lines	4¼	4	4	3½	3½	2½	2	3	2½	1½	1½	
Parrel-rope	4	4	4	3	3½	3	2	3½	3	2½	2¾	

The Bigneſs of the Bow-ſprit Rigging.	Maſt of 34 In. 1 In	Maſt of 32 In. 2 In	Maſt of 30 In. 3 In	Maſt of 29 In. 4 In	Maſt of 28 In. 5 In	Maſt of 27 In. 6 In	Maſt of 26 In. 7 In	Maſt of 24 In. 8 In	Maſt of 23 In. 9 In	Maſt of 19 In. 10 In	Maſt of 13 In. 11 In	Maſt of 12 In. 12 In
Pendants of Sheets	6	6	5½	5½	4½	4	3½	5	4½	4	3	2½
Sheets	4½	4½	4	3	3	2½	2½	4	3½	3¼	3	1½
Clew-lines	3	3	3	2½	2	2	2	3	2½	2	1½	1½
Garnets	3½	3	3	3	2½	2½	2	3	3	2½	1¾	
Pendants of Braces	4	4	3	3	2½	[illegible]½	2½	3	2½	2	1	1½
Braces	2½	2½	2½	2½	2	2	2	2½	2	1¾	1¾	1½
Hallyards	4½	4	3½	3½	3½	3	2¼	3½	3	2¾	2½	2
Tye	7	6	6	6	5	4½	4	6	5	5	4½	2
Bunt-lines	3	3	2½	2½	2	2	1½	2½	2½	2	1½	
Hoſſe	6	6	5½	5½	5	4	3	3	3	3	2½	2½
Lifts	4	3	3	3	2½	2	2	3	3	2½	2	1½

The Bigneſs of the Sprit-ſail Top-Rigging.	1	2	3	4	5	6	7	8	9	10	11	12
Shrouds	3	3	2½	2½	2	2	1½	2½	2¼	2	1½	1
Lanyards	2	1¾	1¾	1½	1	1	1	2	1½	1	1	1
Pendants of Braces	2½	2½	2	2	1½	1½	1½	2	1¾	1½	1½	1
Braces	2	1½	1½	1½	1½	1	1	2½	1	1	1	1
Tye	3	3	3	2½	2	2	1½	1	1½	1½	1¼	1
Hallyards	2	2	2	2	1½	1½	1½	2	1½	1¾	1	1
Clew-lines	2½	2	2	2	1½	1½	1	2	1½	1½	1	1
Pendants of Tackles	3	3	3¼	2	1½	1½	¾	1½			¾	1
Falls to them	2	2	1¾	1½	1	1	1					
Lifts	2	2	1½	1½	1½	1½	1	1¼	1½	1	1	
Puttocks	3	3	2½	2	2	2	2	2½	2	2	2	1
Parrel-ropes	2	2	2¾	1½	1½	1½	1	1¾	1½	1½	1	1

The Bigneſs of the Mizen Rigging.	Maſt of 34 In.	Maſt of 32 In.	Maſt of 30 In.	Maſt of 29 In.	Maſt of 28 In.	Maſt of 27 In.	Maſt of 26 In.	Maſt of 24 In.	Maſt of 23 In.	Maſt of 29 In	Maſt of 13 In	Maſt of 12 In.
The Mizen-Maſt.	1 In	2 In	3 In	4 In	5 In	6 In	7 In	8 In	9 In	10 In	11 In	12 In
Pendant of Tackles	5½	5	4½	4 }								
Runners	4	3½	3½	3 }								
Falls of Tackles	3	3	2½	2½								
Shrouds	5½	5	4¾	4½	3½	3	2½	4	4	3	2	2½
Lanyards	3	2½	2½	2½	2	2	1½	2	2	1½	1½	1½
Tye	7	6½	6	5	5	4½	4					
Hallyards	5	4½	3½	3	2½	2½	2	3½	3	2½	2	
Stay	6	5	4	3½	3½	3½	3	4	4	3	2½	2½
Lanyards	3½	3	2½	2½	2	2	1½	2½	2	1½	1	1½
Sheet	4	3½	3	2½	2½	2½	2	3	3	2½	2	1½
Jeer	5½	5	4	3½	3½							
Truſs	3½	3	2½	2½	2	2	1½	2½	2	2	1½	
Bow lines	4	3	2	2	2	2	1¾	2½	2	1½	1½	1½
Brayles	2½	2	2	2	2	2	1	2	1¾	1½	1½	1
Parrel-rope	5½	5	4	3	3	3	2½	3½	3	2½	2	2

The Croſs-jack,	1	2	3	4	5	6	7	8	9	10	11	12
Lifts	4	3½	2½	2½	2	1½	1	2½	2½	2	1½	1
Braces	2½	2½	2	2	1½	1	1	2	1¾	1½	1	1
Pendants	3½	3	2½	2¼	2	1½	1¼	2	1½	1¼	1	1
Hallyards	4	3½	3	3	2½	2	1½	2	1¾	1½	1½	1½

Bigneſs of Mizon-top-maſt Rigging.	Maſt of 34 In. 1 In	Maſt of 32 In. 2 In	Maſt of 30 In. 3 In	Maſt of 29 In. 4 In	Maſt of 28 In. 5 In	Maſt of 27 In. 6 In	Maſt of 26 In. 7 In	Maſt of 24 In. 8 In	Maſt of 23 In. 9 In	Maſt of 19 In. 10 In	Maſt of 13 In. 11 In	Maſt of 12 In. 12 In
Pendant of Tackles	3½	3	2½	2½								
Falls of Tackles	2½	2¼	2	2								
Shrouds	3	3	2½	2½	2	1½	1	2	2	2		
Lanyards	2	1½	1½	1½	1½	1	1½	1	¾			
Puttocks	3½	3	2½	2½	2	1½	2	1½	1½	1		
Pendant of Braces	2½	2¾	2	1½	1½	1½	1	2	1½	1¾		
Braces	2	2	1¾	1½	1	1	1	1	¾			
Bow-lines	2½	2	1¾	1½	1¼	1	1	1½	1	¾		
Bridles	2	2	1½	1¼	1	1	1	1	1	¾		
Clew-lines	2	2	1¾	1½	1½	1½	1	2	1½	1½	1	1
Tye	3	3	3	2½	2½	2½	2	3	2	2	2	1½
Hallyards	2½	2½	2	2	1½	1½	1¼	2	1½	1½	1½	1
Lifts	2	2	1¾	1½	1½	1½	1	1	1	1	¾	1
Parrel-rope	3	2½	2	1¾	1½	1¾	1½	2	1½	1½	1	1
Runner of the Stay	2½	2½	2									
Pendant of the Stay	3	3	2¼	2	1½							
Top-rope	3¼	3½	3½	2½	2	2	1½					
Parts of the Stay	2	2	1½	1½	1	1	1					
Pendant for Backſtays	3	2½	2½									
Falls	2¼	2	3¾									

The Bigneſs of the Main Top-gallant Rigging.	Maſt of 34 In.	Maſt of 32 In.	Maſt of 30 In.	Maſt of 29 In.	Maſt of 28 In.	Maſt of 27 In.	Maſt of 26 In.	Maſt of 24 In.	Maſt of 23 In.	Maſt of 19 In.	Maſt of 13 In.	Maſt of 12 In.
	1 In	2 In	2 In	4 In	5 In	6 In	7 In	8 In	9 In	10 In	11 In	12 In
Pendants of Tackles	3	3	2½	2	2	2	2					1½
Falls of Tackles	2½	2	3¾	3½	3	3	1¾					1½
Shrouds	3	3	3¾	3½	3	3	2¾	2	2	1¾	1½	1
Lanyards	1¾	1½	1½	1½	1½	1½	1	1	1	1	1	1
Puttocks	3½	3	2½	2	2	2	1½	1½	1½	1	1	1
Pendant of Backſtays	3	3	2½	2	2	2						
Falls to them	2	2	1½	1½	1	1						
Stay	3	3	3	2½	2	2	1½	2	1½	1	1	1
Lanyard	2½	2½	2½	2	2	2	1½	1¾	1¼	1	1	1
Braces	2	1½	1¼	1¼	1¼	1	1	1	1	¾	¾	¾
Pendants of Braces	2½	2½	2	2	1½	1½	1	1	1	1	1	1
Bow-lines	2½	2	1¾	1½	1½	1½	1	1	1	¾	¾	¾
Bridles	2	1½	1¼	1¼	1	1	1	1	1	¾	¾	
Top-rope	4½	4	3½	2½	2	2						
Parrel-rope	2½	2	2	2	1¾	1½	1	1½	1	1	1	1
Tye	3	3	3	2½	2½	2	1¾	2½	2	2	1¾	1¼
Hallyards	3	2½	2	2	1¾	1½	1	1½	1½	1	1¼	1¼
Lifts	2½	2	1½	1½	1	1	1	1	1	1	1	1
Flag-ſtay-ſtay	2½	2	1½	1½	1	1					¼	
Clew-lines	2	2	1¾	1¼	1½	1	1	1½	1½	1¼	1	1

The

The Bigneſs of the Fore Top-gallant Rigging.

	Maſt of 34 In. 1 In	Maſt of 32 In. 2 In	Maſt of 30 In. 3 In	Maſt of 29 In. 4 In	Maſt of 28 In. 5 In	Maſt of 27 In. 6 In	Maſt of 26 In. 7 In	Maſt of 24 In. 8 In	Maſt of 23 In. 9 In	Maſt of 19 In. 10 In	Maſt of 13 In. 11 In	Maſt of 12 In. 12 In
Tye	2½	2½	1¾	1½	1½	1½	1¼	2½	2¾	1½	1¼	1¼
Hallyards	2½	1½	1½	1	1	1	1	1½	1½	1	1	1
Bow-lines	2	2	1½	1½	1¼	1¼	1	1	1	¾		
Bridles	1¾	1½	1½	1½	1½	1¼	1	1	1	¾		
Stay	2½	2½	2	2	1¾	1½	1	1½	1½	1		
Shrouds	2½	2½	2	2	1½	1½	1	2	1½	1		
Lanyards	1½	1½	1½	1	1	1	1	1¼	1¾	¾		
Parrel rope	2	2	1½	1½	1	1	1	1½	1½	1		
Clew-lines	2	1¾	1½	1½	1¼	1¼	1	1½	1½	1		
Braces	2	1½	1¼	1¼	1¼	1	1	1	1	¾		
Lifts	2	1¾	1½	1½	1¼	1	1	1	1	1		
Top-rope	3½	3	3	2½								
Pendant of Tackles	3¼	2½	1½									
Falls	2	2	2									
Puttocks	3	3½	2½	2	1¾	1½	1	1	1	1	1	1
Back-ſtays	2½	2½	2									

Number

Number, Weight, and Size of ANCHORS and CABLES for a Ship of each Claſs.

		Anchors				Cables	
		N°	Weight of each.			N°	Size of each
Rate	Guns		C.	q.	lb.		*Inches.*
1	100	5	77	3	0	9	23½
	Stream	1	20	0	0	1	14
	Kedge	1	10	0	0		
2	90	5	71	3	0	9	22½
		1	17	0	0	1	13½
		1	9	2	0		
3	80	4	65	3	0	8	21½
		1	16	0	0	1	13
		1	8	2	0		
	70	4	56	2	0	7	20½
		1	14	0	0	1	12½
		1	7	2	0		
4	60	4	51	2	0	7	19½
		1	12	0	0	1	11½
		1	6	2	0		
	50	4	46	2	0	7	18½
		1	11	2	0	1	11
		1	6	0	0		
5	40	4	37	3	0	7	17
		1	9	2	0	1	10
		1	5	0	0		
6	24	4	29	1	0	6	15½
		1	6	2	0	1	8
		1	3	0	0		
Sloops.		3	15	0	0	5	13
		1	7	0	0	1	8
		1	3	2	0		

A CORDAGE TABLE, *ſhewing how many Fathoms, Feet, and Inches of a Rope of any Size under* 14 *Inches, makes a Hundred Weight; with the Conſtruction of the Table, and Rules to calculate the Weight of Ropes to any larger Circumference.*

In	Fath	Ft	In	In	Fath	Ft	In	n	Fath	Ft	n
1	486	0	0	6	13	3	0	11	4	0	3
¼	313	3	0	¼	12	2	0	¼	3	5	7
½	216	3	0	½	11	3	0	½	3	4	1
¾	159	3	0	¾	10	4	0	¾	3	3	3
2	121	3	0	7	9	5	6	12	3	2	3
¼	96	2	0	¼	9	1	6	¼	3	2	1
½	77	3	0	½	8	4	0	½	3	2	0
¾	65	4	0	¾	8	3	6	¾	2	7	8
3	54	0	0	8	7	3	6	13	2	5	3
¼	45	5	2	¼	7	0	8	¼	2	4	9
½	39	3	0	½	6	4	3	½	2	4	0
¾	34	3	9	¾	6	2	1	¾	2	3	6
4	30	1	6	9	6	0	0	14	2	2	1
¼	26	5	3	¼	5	4	0				
½	24	0	0	½	5	2	0				
¾	21	3	1	¾	5	0	6				
5	19	3	0	10	4	5	0				
¼	17	4	0	¾	4	4	1				
½	16	1	0	½	4	2	2				
¾	14	4	6	¾	4	1	8				
6	13	3	0	11	4	0	3				

The

The Uſe of the Cordage-Table.

THE Letters *In. Fath. Ft. In.* at the Top of the Table ſignify *Inches, Fathoms, Feet,* and *Inches.* The firſt Column being the Thickneſs of the Rope in Inches and Quarters, and the other three the Fathoms, Feet, and Inches, that make up an hundred Weight of ſuch a Rope. One Example will make it plain.

Suppoſe I deſire to know how much of a 7-Inch Rope will make an hundred Weight; find 7 in the fifth Column under *I.* or *Inches* thickneſs of the Rope, and againſt that, in the ſixth, ſeventh, and eight Columns, you find 9 | 5 | 6; which ſhews, that (in a Rope of 7 Inches) 9 Fathom, 5 Feet, and 6 Inches, is required to make an hundred Weight. And ſo in a 9 Inch Rope, 6 Fathom makes an hundred Weight: And in a 3 Inch Rope, 54 Fathom makes an hundred Weight, *&c.*

The Conſtruction of this TABLE *is from hence.*

A Rope of 1 Inch about, requires 486 Fathom to make up an hundred Weight; and as the ſuperficial Content of all Circles are in proportion to the Squares of their Diameters, (and conſequently to the Squares of their Circumferences) it will follow, that as a Rope of 1 Inch in Circumference, whoſe Square is alſo 1, has 486 Fathom to an hundred Weight; 486 divided by the Square of the Circumference, or Girt of any other Rope, the Quotient will give the Number of Fathoms in an hundred Weight. As for Example: In a 9 Inch Rope, 9 times 9 is 81, by which divide 486, the Quotient is 6, the Fathoms in an hundred Weight. And ſo for a 3 Inch Rope, 3 times 3 is 9, by which divide 486, the Quotient is 54 Fathom to an hundred Weight, as in the Table; and where there is a Fraction in the Diviſion, it may be reduced to Feet and Inches; 6 Feet being Fathom, and 12 Inches a Foot.

A TABLE ſhewing the Weight of any Cable or Rope, of 120 Fathom in Length, and for every half Inch, from 3 Inches to 24 in Circumference.

Inch	C.	qr.	Inch	C.	qr.
3	2	1	14	49	0
3½	3	0	14½	52	2
4	4	0	15	56	1
4½	5	0	15½	60	0
5	6	1	16	64	0
5½	7	2	16½	68	0
6	9	0	17	72	1
6½	10	2	17½	76	2
7	12	1	18	81	0
7½	14	0	18½	85	2
8	16	0	19	90	1
8½	18	0	19½	95	0
9	20	1	20	100	0
9½	22	2	20½	105	0
10	25	0	21	110	1
10½	27	2	21½	115	2
11	30	1	22	121	0
11½	33	0	22½	126	2
12	36	0	23	132	1
12½	39	0	23½	138	0
13	42	1	24	144	0
13½	45	2			

I choſe to inſtance in a Cable of the Length abovementioned, becauſe Yarn ſet at 200 Fathom, will, in the laying of a Cable, work up or ſhorten to 120 Fathom; Cable-laid Ropes working in about two Parts in five; but if it is a half Cable, or a Part of a Cable of any other Length, the Weight of 120 Fathom being found by the Table, the Weight of any leſſer Part is eaſily found in Proportion to its Length.

The Uſe of the TABLE.

THE firſt Column marked Inch for *Inches*, is the Thickneſs or Circumference of the Cable to every half Inch, from 3 to 24; the ſecond and third, marked C. qr. for *Hundreds* and *Quarters*, are the Hundreds and Quarters that it will weigh, if 120 Fathom in Length. As for Inſtance, ſuppoſe a Cable of fourteen Inches and an half; look againſt 14½ in the fourth Column, and you find againſt it in the other Columns 52 | 2; which ſhews, that 120 Fathom of Cable, of 14 Inches and an half about, will weigh 52 Hundred, 2 Quarters, or 52 Hundred and an half; and ſo in others. And any of a leſſer Length will weigh in Proportion.

The Conſtruction of this Table is from hence, that as all Cables are ſolid Bodies, and may properly come under the Denomination of Cylinders; and as ſuch, the Weight of Cables of any determinate Length, will be in proportion to the Squares of their Circumferences. From this Foundation, Experience has formed this general brief Rule, *viz. Multiply the Thickneſs of the Cable by itſelf, and one fourth of that Product is the Weight of* 120 *Fathom.* As for Inſtance; ſuppoſe a Cable of 12 Inches, 12 times 12 is 144, the Quarter of which is 36, the Weight of 120 Fathom of a Cable of 12 Inches; as you ſee in the Table.

Note, This Table gives the utmoſt Weight of Cables of the Length and Size propoſed, and ſomething, through inconſiderably, differs from the foregoing. As for Inſtance; in the foregoing Table 6 Fathom of a 9 Inch Rope makes an Hundred Weight, and conſequently 120 Fathom ſhould be juſt 20 Hundred Weight; but in this it makes 20 Hundred and 1 Quarter; but the Difference is inconſiderable, and the Cables never exceed the Weight here propoſed.

Directions for cutting out SAILS.

HAVING made a Scale, by which the Length of the Keel, *&c.* is laid down, you may obſerve the following Directions.

Fix two Yards, the one hoiſted, the other lowered, or a Portlings; the Top-ſail Yard alſo, the one hoiſted, the other down upon the Cap, and thus you muſt do in all the Models you raiſe.

The Yard a-portlings gives the Length of the Top-ſail Sheets, Lifts, Tye, or Jeers, Bunt-lines, and Leech-lines, or Hallyards, meaſuring from the Hounds to the Deck.

The Yards hoiſted gives the Length of the Clew-lines, Braces, Clew-garnets, Jacks, Sheets, and Bow-lines.

You may alſo find the Length of the Shrouds, Top-ſail Hallyards, Braces, and Lifts.

You may alſo, from a Model thus raiſed, give a near Eſtimation how many Yards of Canvas is in a Main Courſe.

Note. When you come into any Ship or Veſſel, and deſire to know how many Yards of Canvas are in the Main or Fore Courſe: Firſt find, the Depth of your Sail, and the Breadth of the Canvas made uſe of, then take off ſo much from the Scale as you ſee the Cloth is in Breadth, and place ſo many Cloths in the Model, on the Main or Fore Yard, the ſame Depth that the Sail is on. After you have ſo done, take a Fathom or two off from your Scale, and meaſure every Cloth up and down, as you do the Ropes, and that will give you the Yards.

You may alſo, from ſuch a Model, find the Number of Yards that are in the Main or Fore Top-ſail: The ſame Way you meaſure one Sail, you may meaſure all.

But you muſt obſerve, that you are to place the middle Cloth firſt in a Top-ſail, and ſo from thence to each Yard-arm, that your Gores at the Clew may fall out right.

It likewiſe ſheweth the Length of the Main Top-ſail Bow-lines, and of the Fore Top-ſail Bow line. Draw only a Line from the Top-ſail Yard-arm, to the Main Yard-arm, with Ink or Black-lead. *Note*, From the further Yard-arm, that you may take them at the largeſt Extent, and ſo your Braces. You alſo have the Length of the Main Bow-line, Main Sheet, Main Jack, and ſingle Garnet.

As for Braces, draw a Line from the Yard-arm to the Place where the Brace ſhould go: You may draw it double, if you pleaſe, as the Braces go; or you may draw but one ſingle Line, and ſo take a Fathom off from your Scale, and where it goes double, tell two Fathom, where ſingle tell but one.

And for the Fore Top-ſail Sheets, draw a Line from the Top-ſail Yard that is upon the Cap, down to the Yard-arm that is a Portlings; then take one Fathom or two off your Scale, and meaſure from the Top-ſail Yard to the Fore Yard upon the Line that you have drawn, and then from the Fore Yard-arm to the Maſt, and ſo down to the Forecaſtle, and there you have the juſt Length of your Top-ſail Sheets, and it is left to your Diſcretion what Stay you will allow: So likewiſe you muſt do for your Main Top-ſail Sheet, Fore Top-gallant Clew-lines, and Top-ſail Clew-lines; as alſo for any Ropes whatſoever, drawing the Lines, and meaſuring their Lengths,

But Note, That when you meaſure the Stays, you muſt meaſure the Collar firſt double three or four Fathom, according as your Model requires it; for as it becomes the Model, ſo it will appear upon the Veſſel; and obſerve that the Collar belongs to the Length of the Stay.

But for the Pendants of the Braces, you muſt meaſure them firſt three, or two Fathom, as you ſee it will become the Model, there mark the Block, and ſo meaſure the Length of the Brace from that.

AN EXPLANATION

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OF THE Principal Terms, uſed in this Treatiſe.

A

AFT, the after, or hinder Part of the Ship, from the Midſhips to the Stern.

Apron of the Stem, a Part brought on upon it to faſten the Butt Ends to; or a falſe Stem.

B

BACK, the middle Part of crooked Timber, being outward.

Back-Stay, that which ſecures the aft Part of the Maſt.

Beams, are large Pieces of Timber, laid acroſs the Ship; their Ends are lodged on the Clamps, and being bound by Knees to the Side, keep the Ship to her Breadth.

Bearding, the working of one Part of a Plank, or Piece off thinner than the other.

To Belay, to faſten, ſo as may be eaſily looſed again, if requiſite.

Belly, the oppoſite to the Back, or the Inſide of the middle Part.

Bend of Moulds, or a *whole Suit*, one of every Sort.

Bends of Riders, one of a Sort of each Side.

Beſt Bower Anchor, the biggeſt Anchor that hangs at the Bow.

Bevelling, when any Piece of Plank or Timber is not to be wrought ſquare, but in the Nature of a Rhombus.

Bills, the Ends of ſuch crooked Timber.

Birthing, the working up a Ships-ſide, or Bulk-head, &c.

Bit-pin, Pieces of Timber, to which the Ship's Cables are faſtened.

Blocks, ſometimes hard, knotty Timber, to lay under a Ship; otherwiſe the Timbers into which the Ropes are reeved, as Pulleys. We call it *Block and Block*, where two Blocks are haled together, and the Power or Purchaſe diſcontinued.

Bluffneſs, blunt, or full bodied.

Bolts, the Iron Pins, which faſten one Part of a Ship to another.

Bolt-rope, that to which the edges of the Sail are ſewed.

Bow, the round Part of a Ship forward without board, ſo called from *Bowſe Ho*, a Watch Word for all the Men haling a Rope to hale together. That within is termed the *Breaſt*.

Brackets, generally carved Figures for Ornament, or ſhort crooked Timbers reſembling Knees.

Breaſt-hooks, large Knees, fitted to the foremoſt Part within.

Breaſt Back-ſtay, that which is placed at the Side of the Maſt, ſtopping the fore Part as well as the aft.

Breaſt of a Ship See *Bow*.

Breech, the outward bending of Knee-timber.

Bulge, the outermoſt and loweſt Part of a Ship, that which ſhe bears upon when ſhe lies on the Ground.

Bulge-way, a Piece of Timber placed on each Side upon the Bulge, to ſlide a Ship into the Water.

Bulk-heads, the Partitions in a Ship.

Butt, both Ends of every Plank; but in the ſtricteſt Senſe the Ground-End, or the biggeſt End of all Timber.

Buttock, the after or hinder Part of a Ship from the Water to the Gun-room Port.

C

Camber. See *Snying*.

Canting, the turning of Plank or Timber, from one Side to another, in order to ſee the Defects, or for any other Purpoſe.

Carlings, are ſquare Pieces of Timber, lying fore and aft, from one Beam to another, into which they are ſcored.

Cathead, a large ſquare Piece of Timber; one End of it is faſtened upon the Forecaſtle, the other End projects without the Bow, ſo far as to keep the Anchor clear of the Ship, when it is heaving up by a Tackle.

Catting the Anchor, is haling the Stock up to the Cat-head.

To chamfer, to take off the ſharp Edge from any ſquare Piece.

Channels, Pieces of Plank fixed Edge-ways againſt the Ship's Side, making very near a Right Angle with it.

Chine, that Part of the Water-way, or any that is channel'd, which is thicker than the other Part.

Chock, a ſmall Piece of Timber fitted to a larger, to make out the Subſtance required.

Clamps, Pieces, or Strakes of thick Plank on the Inſide, as the Wales are on the outſide of the Ship.

Cock-pit, two Places under the lower Deck, leading to the Store-Room.

Counter, a Part projecting the Stern from the Buttock.

Croſs-pieces, fitted a-croſs the Bit-pins, to which the Cables are belayed.

Crutches, or *Clutches*, large Knees fitted in the aft Part of the Ship in Hold, to bind the Parts together.

D

DAgger-Knees, ſuch as are placed at ſome certain Angle between a Perpendicular and Horizontal; the lodging Knees lying near horizontal, and the hanging Knees perpendicular.

Dead-eyes, Pieces having three Holes through which the Lanyards of the Shrouds are reeved.

Dead-wood, the Parts lying upon the Keel abaft and afore, which being covered both within and without, lie hid, as if they were buried.

Decks, the Plans or Platforms in a Ship, as Stories, or Floors, in a Houſe.

Deep-Load-mark, the horizontal Parallel of the Surface of the Water, when Ship has every thing aboard that ſhe is to carry.

Dove-tail, a Score or Notch, cut bigger within than without, for holding faſt.

Draught, the Model or Figure of a Ship, or any of her Parts deſcribed upon Paper.

Draught of Water, the perpendicular Feet which the Ship has under the Water.

Drifts, Parts projecting upwards, as far as certain Heights are thought proper to be continued.

To Dub, to work with an Adze.

E

TO Eek, to fit a Part for the faſhioning out another more material, as in the Supporter of the Cat-head, and the Cheeks of the Head, where the *Eeking* is only applied to continue the Shape and Faſhion of the Part, and for little other Service.

Edging of Plank, hewing them narrower, according to the Uſe required.

F

FAlſe Keel, a ſort of Covering for the principal Keel.

Faſhion-pieces, two Pieces made exactly alike, and placed one of each Side the Buttock of the Ship, to make both Sides equal and alike.

To Fay, to join Pieces of Timber cloſe together.

Firs, ſmaller Pieces than Chocks, but to anſwer the ſame Deſign, in ſupplying the Wants that may happen in ſome Parts of the Ship.

Fiſhing the Anchor, haling the Flooks out of the Water.

Floor-timbers, the Timbers in the Bottom of the Ship.

Fore, the fore Part of a Ship from the middle forward.

Fore-caſtle, a Place fitted for a cloſe Fight on the upper Deck forward.

G

GAſkets, Rope-Yarn weaved, to make the Sail faſt when it is furled, or bundled up to the Yards.

Ground-ways, large Pieces of Timber lying a-thwart the Bottom of a Dock, or Launch, to make the Foundation firm and ſubſtantial.

H

HAled home, when the Top-ſail Sheets are haled to their Places as far as they can be.

Hanging, the oppoſite to *Snying*, when the Middle of the Plank appears lower than the Planks, but circular.

Harpings, the foremaſt Wale-pieces, which go round the Bow.

Hawſe-pieces, are broad Timbers in the Bow of the Ship, thro' which there are Holes cut for the Cables to paſs.

Head of a Ship, that Part which is faſtened to the Bow, or fore-moſt Part of the Ship without board. It is often carved as an Ornament to the fore Part of the Ship.

Heel, the lower Part of a Maſt, or any Timber.

To heave, to hale or pull by turning round the Capſtan.

Hold of a Ship, the Part under the lower Deck.

To hollow, is ſlenderly to gutter a Plank, or any Part, that the Edges may fay well.

Hoodings ends, the Butt-ends in the Rabbits of the Stem and Stern-poſt, which are more hid by the Rabbits than the other But-ends are.

Hooking, the hitching one Plank into another for ſtopping them.

Horſes for the Yard, Ropes made faſt for the Men to ſtand upon in furling the Sails.

I

JUry-maſts, ſuch as can be got for hoiſting the Sails on, when the principal Maſts are loſt.

K

KEdge-Anchor, is the ſmalleſt of all, and generally uſed to warp or hale a Ship from one Place to another.

Keel, the principal Piece of Timber firſt laid on the Blocks, which ſupports the whole Structure.

Keelſon, a large Piece of Timber, raiſed over the Floor-timbers, and bolted through them into the Keel.

Kevels, ſmall Pieces of Wood for belaying the Braces, and Ropes of a ſmaller Denomination than the Sheets. And as the Ranges are made in one large Piece of Timber, ſo the Kevels are made in three Pieces.

Knee, a crooked Piece of Timber that has one Branch cut off at the Bending, and the other remaining makes the Bend, or Knee-Timber.

L

LAnyard, a ſmall Rope, which faſtens a great one, for the conveniency of being reev'd in Holes and haled taught.

Lapſided, when a Ship ſwims more to one Side than the other, and her Decks are not level to the Horizon.

To Launch, to lower or ſlide a Ship off from the Land into the Water; likewiſe to lower away ſuddenly.

Lazeretto, a Place on Board of a Merchant Ship, for the Conveniency of the Commander, as Store-rooms are on Board of Men of War, to lay up the Proviſions and Neceſſaries for the Voyage.

To let fly, to let go, caſt off, or looſe any Rope at once, without Stopping: And when a Rope is ſo looſen'd, 'tis ſaid to be *flown*.

Limber-boards, are ſhort Pieces of Plank, fayed next to the Keelſon, which may be taken out to clear the Limber-holes, that are left either below, or above the Floor-timbers, for a paſſage for the Water to the Pump.

To Line, to cover one Piece with another; alſo to mark out the Work with a ſmall Line chalked.

Load-mark Line, the horizontal Line at the Surface of the Water.

Looſ, the aft part of the Bow of a Ship between the Stem and the Midſhips.

M

MIdſhip, 'tis generally meant of all the Ship, from the Main Maſt to the largeſt part of the Ship, where the Midſhip Flat, or Midſhip Floor-timber lies.

N

NOG, a Trenel drove in at the Foot of each Shore, or the Props that ſupports the Ship.

O

OVerlaunching, ſplicing or ſcarfing one Piece of Timber to another, to make firm Work.

P

PArtners, Pieces fixed to ſteady the Maſts and Capſtans, having a whole through each to receive the ſame.

Paunch, thrumb'd Mats, much for the ſame purpoſe as Puddening.

To Plum, to hew any Piece downright, or perpendicular.

Plummet, a Weight hanging by a Line to prove the Plumming.

Poop, the uppermoſt Deck abaft.

Preventers, Ropes that have Wale Knots at each End, chiefly uſed in Sea-fights. For when the Rigging is in part ſhot, ſuch Ropes are applyed to prevent the damaged Ropes being quite broke off.

Project, any thing that juts out in the Building; as of the Counter, Wales, *&c.*

To Pudden the Yards, to nail Pieces of old Rope round them, to preſerve them from galling.

Q

QUarter, the upper after Part of the Ship on the Outſide, and may be reckoned to commence from the middle of the Ship.

Quarter-pieces, large carved Pieces fixed to terminate the Quarter with the Stern.

To Quicken the Sheer, to ſhorten the Radius that ſtrikes out the Curve. Its oppoſite is ſtraitening the Sheer.

Quick-work, that part of a Ship's Sides both within and without Board, above the Channel-wales and Decks. 'Tis ſometimes performed with Deal, which don't require the faſtening, nor the Time to work it, as the other Parts, but is quicker done.

R

RAbbit, when a Plank is faſtened to any Piece of Timber, ſuch as the Stem, or Poſt, there is ſo much Wood cut out of the Piece, as the Plank is thick, which is called a Rabbit.

Rails, are narrow Planks, generally of Fir, upon which there is generally a Moulding ſtruck. They are chiefly for Ornament, and nail'd a-croſs the Stern, above the Wing Tranſom and Counters.

Rake of the Stem and *Stern-poſt*, that part of the Ship's Hull that is extended fore and aft, from the ſtrait or horizontal Line of the Keel.

Ram-line, a Line made faſt at the Stem and Stern-poſt, hanging crooked by being weighed in the Middle.

Rangers, Pieces fitted to the Ship to belay or faſten the Main and Fore Sheets

To Reconcile, to make one Piece of Work anſwer to the Uniformity of the other next to it, and more particularly in reverting of Curves.

Ribbonds, or *Ribbands*, ſo called from binding the Ribs or Ship's Timber together.

Riders, Pieces fixed on the Inſide of the Ship on the In-board Plank, ſomething imitating the Ships Timbers or Ribs,

Rother, or *Rudder*, a Piece of Timber, or ſeveral Pieces faſtened together, and fitted to the Stern poſt by Irons ; the Ship is ſteered by it.

Rough Timber, that which is only cut down, and the Boughs lop'd off, being hewed into Squares, 'tis ſaid to be *Rough-ſquared* according to the different Species.

Round-ſterned, to have ſharp or pointed Sterns, as ſquare Sterns are blunt and flat.

Runner, a ſingle Rope that runs or is hauled in a Block.

S.

SCantling, the Length, Breadth and Depth, or Thickneſs of any Part of the Ship, or Pieces of Timber.

Seams, the Chinks into which the Oakum is drove between the Strakes of Planks.

To ſet Sail, to looſe the Sails and manage them to the Wind.

To ſhorten Sail, is to haul ſome up in order to ſail ſlower.

Seaſoned Plank or *Timber*, ſuch as is thoroughly dry, and will not be apt to ſhrink.

Sheet-Anchor, bigger than either the Bow-Anchors.

Shaken Plank or *Timber*, ſuch as is full of Clefts, and will neither bear caulking or faſtening.

Shank-painter, a Chain, or a large Rope, to ſecure the Anchor, and paſſed about the Shank of the Anchor.

Shifting Planks, the putting one But-end clear of another.

Sholes, Pieces of Slabs put under each Shore for the better ſecuring the Weight.

Shivering, when the Sail ſhakes, and is not filled with the Wind and bunted out.

Shrouds, Ropes that ſupport the Maſts.

Sir-mark, a particular Mark made to guide the Workman in placing the Parts.

Sleepers, thick Strakes of Plank lying fixed in the Bottom of the Ship.

Snying, an arching upwards, where the middle of a Plank appears higher than the Ends.

Sole of Planks, the flat Side of them.

Spirkit-riſing, the Plank fixed between the Decks and the Ports for raiſing up the Side within Board.

Standers, Knees fitted upon any of the Decks; alſo Pieces placed to raiſe Stages or Scaffolds.

To Steal, in Planking, is to have more Strakes in the Middle of the Ship than at the Stem or Stern-poſt.

Steaving, when a Part riſes from an horizontal Poſition, as in the Cat-head, Bowſprit, and Knee of the Head.

Stem, the intire foremoſt Part of a Ship.

Steps for the Maſts, large Pieces of Timber fitted at the Bottom of the Ship to ſteady and ſecure the lower Part of each Maſt, which is alſo called a Step.

Stern, the hinder or after Part of a Ship, in which are all the Cabbin-lights.

Stern-poſt, that ſtrait Piece of Timber at the after End of the Ship, which unites both the Sides; the Heel of it is tenanted into the Keel, and the Wing-tranſom faſtened at the Head of it.

Strake of Plank, one Breadth of ſuch Materials wrought either within Board, or without, from one End of the Ship to the other.

Stream Anchor, which ſtops the Ship in tiding up a River.

To Strike, to draw a Line, or delineate a Circle.

Strings, Parts uſed to ſtrengthen, and what are called Clamps in the lower Parts, are termed Strings upwards.

To Sweep, to deſcribe or mark out a Circle with any Inſtrument: And the Circle ſo marked out is generally called a Sweep.

T

TACK-piece, that to which the Fore-ſail is tacked down.

Taſting of Plank or Timber, chipping of it with an Addice, to try the Defects.

TackleFall, the Rope, that being in reeved in blocks or pullies, is handed down to the Deck to be haled.

Taught or Tight, the ſtretching of a Rope, that it may not hang ſlack or looſe.

Term-pieces, the finiſhing Pieces, or thoſe which terminate the Drifts.

Thick-ſtuff, all Plank (as it may be termed) which is thicker than 4 Inches.

Throat, the inward bending of Knee Timber.

Timbers, in a Ship, are as the Ribs in the Body, and ſerve to ſupport the Sides, the Planks being all faſtened to them; the two aftermoſt are called Faſhion Pieces, and ſupport the Ends of Tranſoms.

Top-ſail a-trip, when it is juſt hoiſted.

Top-timber, the uppermoſt Timbers in a Ship.

To trim a Ship, to load and equip her, and put her into a Condition for Sailing; alſo to caulk, clean, and dreſs a Ship, and do any ſmall matter in repairing her, or to fine-draw the Plank or Timber.

Tuck-ſquare, is, when the Heels of the Faſhion Pieces are let in upon the Poſts, at which Place the Height of the Tuck is fixed.

Tumbling-home, when the Ship-ſide declines from a Perpendicular upwards, or, as ſome call it, houſes-in.

V

Viol, a large Hawſer uſed to heave in the Cable.

W

Wake, or *Way*; the bringing one Part of a Ship too near another.

Wales, Pieces, or rather Strakes of thick Plank, by which the Ship is regularly ſheered and curved, and which alſo projects without the other Plank ſeveral Inches.

Wall-ſided, when the Ship's Side upward is built upright or perpendicular.

Waſte, that Part of a Ship upon the upper Gun-deck between the Bulk-head of the Steerage and Fore-caſtle.

Water-ways, thick Plank channel'd or gutter'd, and fixed on the Decks next to the Ship's Side.

Within-board, within-ſide of the Ship; as *Without-board*, on the out-ſide.

Winding, when the Plank or Timber's Side or Edge is not upon a direct Plan, but ſeemingly twiſts.

Wood and Wood, when a Trenel is drove through, that the Point of it is directly with the Plain of the Plank through which 'tis drove.

Woulding, the binding about a Maſt, or the like, with Ropes.

Wrung heads, that Part between the Floor-timber Head and ſecond Foot-hook Heel, which, if a Ship lies on the Ground, bears the greateſt Strain.

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